CLINICAL CASE-TAKING

ROBERT D. KEITH

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AN INTRODUCTION TO ELEMENTARY CLINICAL MEDICINE

BY

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AS A TOKEN OF ADMIRATION

AND GRATITUDE.

PREFACE

THIS little book was written for the students of the King Edward VII. Medical School, Singapore. The first draft had just been completed when the author had perforce to return to Europe, and it has been only lately, during convalescence from a serious illness, that he has been able to turn his attention to it again. As he is not returning to the East, it has been suggested to him that the booklet might be made available to a wider circle of students, and this suggestion he now ventures to follow in the hope that students and even teachers of elementary Clinical Medicine may find it of some value.

The author's own students appeared to derive a considerable amount of interest and knowledge from the course embodied in the book ; this fact has emboldened him to place it before a wider public.

It was originally intended that numerous illustrations should accompany the text, and a considerable number of these were in course of preparation when the work had to be abandoned temporarily ; for various reasons it has been found necessary to omit them altogether.

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CHAPTER I

INTRODUCTORY

GENERAL ADVICE TO STUDENTS—WARNINGS—SCHEME TO BE FOLLOWED

In examining a medical case our object should be to do it so systematically and thoroughly that, when we have finished, we shall be quite certain that no point of importance has been omitted. In order that we may effect our object we must have a thorough acquaintance with all useful, practical methods of examination and investigation; we must have a sound grasp of the principles which underlie these methods. We should not neglect, also, from time to time to maintain and extend our knowledge of Anatomy and Physiology and their latest developments. Physiology is the mother of Clinical Medicine.

Every teacher of Clinical Medicine has his own method. The best is that which aims by question and answer at extending knowledge from existing knowledge, the object being to train the reasoning faculty and so enable us to draw sound conclusions from facts; in this way we render ourselves less dependent on mere memory

and more fitted to solve problems as they arise; it is the exercise of this faculty that gives us half the pleasure we get from our profession. It is a matter of great difficulty, however, to reduce this interrogatory method to print, and in the following pages no attempt has been made to do so. Students may be assured that long after they have finished their curriculum and have begun to deal with actual cases, especially in private practice, they will remember many helpful facts which have been taught them in this way when much that they have read and have had imparted to them didactically has been utterly forgotten. Incidentally it is not always the teacher who knows most or who teaches most facts that is the best from the point of view of the student; enthusiasm both in student and teacher is the first essential point in Clinical Medicine as in every other subject. Enthusiasm and thoroughness: these should be our guiding principles.

To begin with, the student should pursue a definite plan such as that given below. It is one that evolved itself during the progress of a course of elementary Clinical Medicine given in the wards of one of the Singapore hospitals, and bears, in consequence, traces of its tropical origin; but in view of the tropical nature of a large part of our Empire, and considering that in consequence of our campaigns in tropical lands diseases peculiar to these regions will be much oftener seen in future in Britain, it will probably be no disadvantage for the student to be made acquainted with some of the elementary facts bearing on such conditions. The scheme will probably be found to be as useful as most others of this kind; it is of little use, however, except as a guide to the beginner, nor can it be applied properly until it has been explained and illustrated in as practical a manner as possible, each step being mastered before

another is taken. The student should do everything for himself repeatedly, till the teacher is satisfied that proficiency has been obtained: again, one would repeat, thoroughness should be our watchword. A thorough mastery of the rudiments of Clinical Medicine, or, in other words, of Clinical Case-taking, will ensure a sound foundation on which to build a knowledge of general Clinical Medicine.

At the risk of appearing tedious and finicking, I should like to warn beginners against making hasty assumptions and jumping to conclusions without having thoroughly investigated the facts of the case. I have known students and others conclude quite wrongly that a man who complained of "fever" was suffering from malaria. It is quite true that in many tropical places malaria is by far the most frequent cause of "fever," but it is not by any means uncommon to find people complaining of "fever" who do not, as a matter of fact, have any rise of temperature. Another dangerous diagnosis is "neurasthenia" or "neurosis." It is a diagnosis which is, unfortunately, often made rashly and without proper investigation, and is one which may be pernicious and cruel to an extreme degree, and may do a patient grievous injury. No one would willingly make such mistakes, but even the best physicians get weary at times and may have to resist the temptation of making a hasty diagnosis. That such things occur is my excuse for labouring this point.

In teaching, it is well to use as simple and direct language as possible, and in the following pages I have tried to do so. My experience has been that, in general, students find it easier to assimilate and retain facts simply expressed. I mention this as I wish to be of use to as large a number of students as possible, irrespective of their preliminary mental training.

The following scheme is merely a guide; with sufficient practice the student will be able to dispense with its use.

Scheme for the Clinical Investigation of a Medical Case

Name .....Occupation.....

Age .....Nationality .....

Address .....Chief Complaint .....

Diagnosis .....

I. **Previous Personal History.**—Previous illnesses; at what age; duration of each; nature; any attack similar to the present.

II. **Family History.—Parents and Grandparents:** are they alive; if alive, their ages; are those alive well or do they suffer from any particular form of illness; if any dead, at what age and from what cause did they die. **Brothers and Sisters:** how many alive; if any dead, at what age and of what diseases. Is patient married; any **children**; are these healthy; if any dead, of what did they die; is wife healthy.

III. **History of Present Illness.**—Ask patient how long it is since he was quite well; what did he notice first; how long did the symptoms last; have they gone; are they better or worse if still present.

IV. **Present Condition.**

1. Expression and appearance of face.
2. Decubitus.
3. State of nourishment.
4. Bodily configuration.
5. Any peculiarities: *e.g.* cyanosis, œdema, jaundice, anæmia, peculiar skin conditions—exanthemata

and other rashes, scars on body, fever, dyspnœa, cough.

V. **Circulatory System.**

1. Note any *pulsation* in the neck, chest, or abdomen, with the exact situation, and whether systolic or diastolic.
2. *Examine pulse*: (*a*) rate, (*b*) force, (*c*) rhythm, (*d*) tension, (*e*) condition of arterial wall, (*f*) volume, (*g*) any abnormal waves, (*h*) whether synchronous and equal on both sides or not, (*i*) water-hammer pulse, (*j*) capillary pulsation.
3. *Heart:* (*a*) *Inspection* of præcordia—pulsating areas, swellings.
   (*b*) *Palpation*, (i) Apex beat or pulsation elsewhere, (ii) thrill, (iii) swellings.
   (*c*) *Percussion*, (i) Superficial cardiac dulness, (ii) deep cardiac dulness, (iii) abnormal swellings.
   (*d*) *Auscultation*—Mitral, aortic, pulmonary, and tricuspid areas; (i) sounds, (ii) murmurs.
4. *Blood pressure*: Sphygmomanometer.

VI. **Respiratory System.**

1. *Inspection*—(*a*) Rate and nature of breathing, (*b*) type of breathing, (*c*) expansion and movement, (*d*) type of chest, (*e*) covering of chest, (*f*) any special bulging or retraction.
2. *Palpation*—(*a*) Expansion of chest, (*b*) vocal fremitus.
3. *Percussion*—(*a*) Any difference between the two sides, (*b*) any dulness, (*c*) any hyper-resonance, (*d*) "cracked-pot" sound.
4. *Auscultation* (listen for the breath sounds)—(*a*) Ordinary quiet breathing and forced respiration, (*b*) adventitious sounds, (*c*) voice sounds; vocal

resonance, ægophony, (*d*) special signs like the "bell sound" and "succussion splash."

VII. **Digestive System.**

1. *General Observations*—(*a*) Tongue, teeth and gums, (*b*) ability to swallow properly, (*c*) special symptoms such as pain, vomiting or nausea, acid eructations, flatulence, (*d*) movement of bowels, constipation, diarrhœa, nature of motions.
2. *Examination of Abdomen*—(*a*) *Inspection :* general shape, distension or flattening, local swellings, distended veins, peristaltic waves, (*b*) *Palpation :* tenderness, contraction of muscles, "boarding," any special swelling and its characters, transmitted thrill, splashing; palpation of liver, spleen and kidneys, (*c*) *Percussion :* dulness, resonance, shifting dulness.

VIII. **Nervous System.**

1. *Peripheral Nerves*—Conduction, (*a*) *motor nerves*—flexion and extension of (i) toes, (ii) foot or ankle, (iii) knee, (iv) hip, (v) wrist, (vi) elbow, (vii) shoulder, (viii) muscles of trunk and neck. (*b*) *Sensory nerves*—(i) light touch, (ii) pain, (iii) heat and cold, (iv) pressure, (v) stereognostic sense.
2. *Spinal cord*—Reflexes; (*a*) superficial: (i) plantar (Babinski's sign), (ii) cremasteric, (iii) umbilical, (iv) epigastric; (*b*) deep: (i) knee-jerk (reinforcement), (ii) ankle-clonus, (iii) supinator, (iv) wrist, (v) triceps, (vi) deltoid jerks; (*c*) visceral or organic: (i) rectal, (ii) vesical, (iii) sexual.
3. *Brain*—(*a*) Base; cranial nerves; (*b*) higher centres and functions; co-ordination, gait, equilibration, memory, speech, delusions, hallucinations, sleeplessness.

IX. **Chemical and Microscopical Examination.**

1. *Urine*—(*a*) Amount, (*b*) specific gravity, (*c*) colour, (*d*) odour, (*e*) reaction, (*f*) abnormal constituents — albumin, sugar, bile, blood, acetone, di-acetic acid, (*g*) deposits, (i) unorganised and (ii) organised—macroscopic and microscopic appearances.
2. *Fæces*—Characters of stool; microscopic examination for parasites, ova etc.
3. *Sputum*—(*a*) Wet films, (*b*) stained films.
4. *Blood*—(*a*) Wet and stained films, (*b*) estimation of hæmoglobin, (*c*) blood-counts.

CHAPTER II

GENERAL EXAMINATION

PREVIOUS PERSONAL HISTORY—FAMILY HISTORY—HISTORY OF PRESENT ILLNESS—PRESENT CONDITION

We naturally begin the examination of a case by taking the name, age, occupation, address, and nationality of the patient, not only for present information but also for future reference.

The patient, as a rule, comes to consult the physician on account of something more or less definite—pain, sleeplessness, breathlessness or some other prominent symptom. This we may call the chief complaint or symptom, and, while we duly note it, we must on no account be led away to look on it as the disease; that is a very frequent source of error, and one of the main objects of a course of elementary Clinical Medicine is to teach the student to avoid this and similar pitfalls. A patient may give a diagnosis of his own, but you must never accept this without making a full examination; on the other hand, you should listen patiently to what he has to say; you should ever be kind and sympathetic if you wish to gain and retain a patient's confidence.

Previous Personal History

If the patient is moderately intelligent, and if you can understand his language, it is well to enquire what

illnesses he has had, how long they lasted, whether they resembled the present attack, and anything else that may be of interest and have a bearing on the case. Patients are apt to be long-winded and irrelevant, and too much time should not be spent over this point. In dealing with natives of the coolie class, indeed, we might as well omit this part entirely in the majority of cases, especially if we are working with an unfamiliar dialect.

Family History

Here, again, unless the patient is intelligent, we must not linger. Our object is to find out if there be any history of any special disease, particularly amongst near relations, such as a tendency to bleed or bruise easily, to consumption, gout, syphilis, and so on. The precise line of enquiry will depend on the exact nature of the case, but we must not waste over conjecture, time which might be devoted to exact methods.

History of the Present Illness

If you ask a patient to tell you about his illness, he will probably enter on a long story, most of which is inaccurate and away from the point. This is not invariably the case, naturally; but if you find that he does not keep to the point, you should ask how long it is since he was quite well. From that you may progress by finding out what he then noticed, and on this depends how the enquiry will proceed. Your object is to get a short, succinct story without any irrelevant matter, and, for the beginner, this is difficult, as he does not realise what is of importance and what is not; it is only after a certain amount of knowledge of the diseases of the various systems has been acquired, that

we can pick the wheat from the chaff and know what to include and what to reject. The patient's description may lead you to implicate a certain system of the body; you will then proceed to ask questions in accordance with the instructions given in connection with each system. On the other hand, it may not be evident that any special part of the body is at fault. The patient may complain, for example, of repeated attacks of "fever," and in a malarious locality such a statement naturally leads one to think of malaria to the exclusion of other causes, perhaps. In such a case it is our duty to find out whether the patient has been living in a malarious locality, and how frequent and of what nature the attacks of "fever" have been. It is quite likely that there may not have been any fever at all, "fever" being an elastic term which covers a multitude of ailments; but, as far as we can in the time at our disposal, we should get as accurate a description of the condition as possible, and so with any other general complaint. Here, again, we must not sacrifice exactitude to conjecture; but it must be borne in mind that even after all exact methods have been exhausted, there must remain a smaller or larger residue of cases in which the diagnosis depends on the history given by the patient. The more thorough the physician is in his methods of examination the smaller will this residue be, and, while experience and the use of new and improved methods will tend to diminish it still further, it will not become sufficiently small unless experience is combined with thoroughness.

Present Condition

Before actually beginning to make a physical examination of the various systems you must observe closely the general condition of the patient. He may be so

manifestly ill that even an untrained observer can see it ; on the other hand, the illness may be of such a nature that only a skilled physician would notice the visible signs of disease. You note whether your patient looks ill or well ; you should observe whether the expression of his face denotes pain or distress. There are other conditions, such as the sunken eyes, prominent nose, and tightly-drawn facial skin of the opium smoker, the pale, puffy face of certain cases of renal disease and ankylostomiasis, the yellowish earthy hue of chronic malaria, and so on, which you will recognise only after seeing many cases.

Attention should be paid to the **decubitus** or position of the body. Some patients are equally comfortable in all positions, while others can lie only on the right or the left side ; some prefer to lie on the back, others on the face, and in certain cases of cardiac and pulmonary disease the patient has to adopt the sitting posture—orthopnœa.

The bodily configuration—whether robust, slim, or deformed in any way—is of importance; but even more so is the state of nourishment of the body. Great emaciation indicates some wasting disease or starvation.

In cases of **unconsciousness** one notes whether the patient is completely oblivious to his surroundings and external stimuli, or whether it is possible to obtain some response from him. Naturally one does not subject him to rough usage, but one observes the effects of a strong light, a loud noise, and similar stimuli.

There are a number of peculiar features, one or more of which may be present: pallor, jaundice, cyanosis, pigmentation of the skin, the rashes of exanthemata, syphilis, and other conditions, abnormal stoutness, œdema, shrivelling of the hands and feet, dyspnœa, fever, constant distressing cough, flushing of the face,—

any of these or any other prominent feature should be duly recorded.

These points are of importance, because, after you have acquired some knowledge of Systematic Medicine, they lead you to lay particular stress on some special method of examination, or attract your attention to a certain system or organ ; but not under any circumstances are you to allow yourselves to make a diagnosis from observation of this kind alone : that will surely, sooner or later, land you in disaster.

The temperature of the patient is of great importance always, but doubly so in a malarious country, where " fever " is the most common complaint, (and excuse). If the temperature is 99° F. or over, the patient is said to have fever or pyrexia, the causes of which are very numerous. As a rule in hospitals the temperature is taken every four hours. In general it is higher at night than in the morning, but not necessarily so, and if we take it only in the morning and at night we may miss a rise sometime during the day. If possible the temperature should be plotted out on a temperature chart.

At this stage you should be made acquainted with some facts relating to temperature. If the pyrexia follows no definite course, but rises and falls at irregular intervals, it is said to be **irregular** ; it may rise suddenly, or gradually by a series of step-like ascents, and, when it has reached its highest point or **acme,** it may remain at that height, not varying more than one and a half degrees during the day ; it is then termed **continuous.** On the other hand, it may fluctuate several degrees daily but without reaching the normal (98·4° F.), being then termed **remittent.** If it fluctuates more than the normal daily range in health, that is, over one to one and a half degrees, and if it does reach the normal at some period daily, it is called **intermittent** ; a temperature

that constantly remains below 98·4° F. is said to be **subnormal.** A temperature of over 105° F. denotes **hyperpyrexia.** If the temperature subsides rapidly it is said to fall by **crisis**; if gradually, by **lysis.** Terms like quotidian, tertian, quartan are employed in describing the various forms of malaria and will not be gone into at this stage.

CHAPTER III

CIRCULATORY SYSTEM

SYMPTOMS OF CIRCULATORY DISEASES—EXAMINATION OF PULSE AND HEART BY ORDINARY CLINICAL METHODS

We now proceed to examine the various systems in detail, and we begin with the **circulation.** Although we examine this system in every case, there are certain symptoms and signs which would draw our attention to it more particularly, amongst them being breathlessness, especially on exertion, palpitation, cyanosis, pain over the præcordia or down the left arm, and swelling of the feet and ankles.

Now, in examining the circulatory system, we must not immediately rush at the heart. The first thing we do is to examine the pulse at the wrist in the following way. The patient's hand and arm should be lying on a bed or table, or should be supported by the non-examining hand of the observer. We then place the tips of three fingers over the radial artery at the wrist: the lowest prevents a reflex wave from ascending from the palmar arch, the middle feels the beat, the upper compresses the artery in such a way that we can estimate how much force is required to obliterate the beat. It is well, as a routine measure, to feel the pulse at both

wrists, and in certain cases it is imperative, *e.g.* in cases of suspected aneurism of the aorta.

The following are the points of importance :

(1) Frequency, (2) force, (3) rhythm, (4) tension, (5) condition of the arterial wall, (6) volume, (7) abnormal waves, (8) synchronicity and equality or the reverse on both sides.

Frequency.—The usual rate is about 72 per minute. It is normally much more frequent in children and less so in old age. If the pulse-rate in an adult is persistently over 90, or thereby, (apart from special characteristics such as fever and exertion), **tachycardia** is said to be present ; on the other hand, if the rate is habitually 50 or under, **bradycardia** is the term applied. In some cases the **pulse-respiration ratio** is of importance. This means the number of pulse-beats in proportion to the number of respirations per minute, and it is usually about 4–1. We must remember that slight causes, such as mental excitement, emotion and exertion, will cause a considerable increase in the pulse-rate.

Force.—This means the strength with which the wave comes up against the examining finger ; if the strength of all the beats is equal the pulse is said to be regular in force, whereas if the strength is unequal it is said to be irregular in force.

Rhythm.—If the pulse-waves follow each other at equal intervals the pulse is termed regular in rhythm, but if at unequal intervals it is irregular. Such an irregularity may be either a regular or an irregular one : *e.g.* if every second, third, or fourth beat is missed or weak the pulse is regularly irregular, whereas if the weak or missed beats come at no definite interval we have an irregular irregularity.

Tension.—There are two kinds of tension, the systolic and the diastolic. Systolic tension can be roughly

estimated by the amount of pressure of the finger required to obliterate the pulse-wave, and, at best, it is but a rough approximation to the truth. If we wish to get a more accurate estimation we must employ some modification of the Riva-Rocci sphygmomanometer; for the diastolic tension we are dependent on instrumental methods which are beyond the bounds of an elementary course. It is true that the vessel may give the impression of being very full and tense between the beats, but it is very difficult to distinguish this condition from a thickened arterial wall. High pulse-tension or blood-pressure is sometimes known as **hyperpiesis**, and is present in diseases of the vessels and kidneys and in a number of other conditions.

Condition of the Vessel Wall.—Sometimes we find that the vessel can be rolled under the tips of the fingers; this may not necessarily be due to disease—arteriosclerosis—of the vessel wall, but merely to high tension. The extent to which the vessel can be rolled under the fingers varies very much; in some cases it feels like a thick cord, in others the condition is just noticeable.

Volume.—This practically means the size of the pulse-wave: thus we speak of a pulse of full, medium, or small volume when the wave is of a large, medium, or small size; similarly, when the waves are frequent and just perceptible to the finger-tips, it is said to be thready or running. In certain cases it may be imperceptible.

Presence of Abnormal Waves.—The presence of a dicrotic wave indicates that the aortic valve is intact and that the pulse is of low tension: these abnormal waves are much better studied by the sphygmograph.

Water-Hammer Pulse.—This is sometimes known as a collapsing pulse, and is found in cases of aortic

regurgitation. It is characterised by its sudden impulse against the finger and its rapid fall; its characteristics are made more evident by holding the patient's arm well above the level of the heart.

The Examination of the Heart

There are certain facts which you must bear in mind with regard to the heart; they are briefly as follows:

The **præcordia** is the region of the chest in front of the heart. Its boundaries coincide with those of that organ and may be mapped out thus: it is bounded above by a line drawn from the lower border of the second left costal cartilage to the upper border of the third right, on the left extending half an inch to the left of the sternum and on the right just beyond the margin—the base line. The right border is demarcated by a line curving somewhat to the right and joining the right extremity of the base line with the junction of the sixth right costal cartilage with the sternum, while the lower border extends from the lower extremity of the right margin to the apex beat, a point nominally in the fifth left intercostal space, $3\frac{1}{2}$ inches from the middle line of the sternum. The line which maps out the left margin joins the apex beat to the left extremity of the base line.

The base of this area corresponds to the origin of the great blood-vessels from the root of the heart, the right margin to the right auricle, the lower border to the sharp margin of the right ventricle, and the left boundary to the left or rounded margin of the left ventricle. The greater part of the front of the heart is formed by the right ventricle and auricle and the back by the left. The student should take every chance of investigating these points for himself in the dissecting and *post-mortem* rooms.

The four methods usually employed in examining the cardiac area are: (1) inspection, (2) palpation, (3) percussion, (4) auscultation.

Inspection.—The front of the chest should be exposed and observed in a good light. We do not touch the chest, but merely look at it. Before our observations can be of any use, we must know what we have to look for, and, even then, it will take time and practice before our opinion is of any great value. Get to know exactly what a normal cardiac region looks like by inspecting many healthy chests, and then you will be able to recognise abnormalities when they occur. First you must notice whether there is any undue prominence or depression (sometimes spoken of as abnormal bulging or retraction). An abnormal bulging may indicate fluid of some kind in the pericardial sac or even a tumour in the præcordial region; on the other hand, it may mean hypertrophy of the heart itself. Retraction here is usually due to adhesions between the visceral and parietal layers of the pericardium, and, perhaps, even between the pericardium and the chest-wall. It may also be caused by disease of the lung causing adhesion to the thoracic wall and retraction.

We must give attention, too, to movements in the præcordial area. In a healthy person the only movement that can usually be seen is in an area about an inch in diameter which we call the apex beat, the position of which has already been mentioned. Sometimes, however, we find that the apex beat is not visible, a condition which may be due to its being placed somewhat out of its position behind a rib, or to fluid in the pericardium, or overlapping by an emphysematous lung. On the other hand, we may find that the extent of the apex beat is much larger than in health; it may, indeed, cover an area as large as the palm of the hand or even

larger, and may extend well into the axilla and down as far as the seventh intercostal space. An increase of this kind may be due (1) to retraction of the left lung, (2) to hypertrophy or dilatation, or both, of the heart.

In or near the præcordia there may be abnormal pulsating areas. In the second and third left intercostal spaces, in cases of anæmia, we sometimes find a wavy pulsating area. Behind the sternum or to the right or left of the manubrium there may be a heaving pulsation caused by an aneurism of the aorta. There may be epigastric pulsation, due (1) to pulsation of the aorta in emaciated or nervous persons; (2) to aneurism of the aorta; (3) to a tumour lying over the aorta; (4) to passive congestion of the liver; (5) to dilatation of the right ventricle. If we wish to time any pulsation, *i.e.* to find out whether it is systolic or diastolic, we should place the tips of the fingers over one of the carotids; if the pulsation which we are investigating occurs at the same time as the carotid heave it is systolic, if after, it is diastolic.

Palpation.—By palpation is meant feeling with the palm and fingers of one hand. Do not feel with the tips of the fingers; if you do you will probably miss what you are trying to discover. Afterwards you may use the finger-tips to examine more closely any point you may be in doubt about. What, then, do we expect to detect by palpation? We wish, by placing the hand, palm downwards, over the recognised area, to ascertain whether the apex beat is present. (Begin by feeling for the normal features, not the abnormal.) If the patient is lying down it may not be possible to feel the apex beat, as the heart tends to fall away from the chest-wall, but, by making him sit up—if he is able—and by making him lean forward, the apex beat may be elicited. Even thus, however, it may not be felt; as we have previously

seen it may be obscured by overlapping lung, by fluid in the pericardium, or by fluid in the pleural cavity. On the other hand, the area may be increased in size owing to retraction of the left lung, or enlargement of the heart.

It may be displaced to the right or left by fluid or gas in the pleural cavity; in such cases it may even be found on the right of the sternum.

We note, then, the size of the pulsating area which represents the apex beat, its exact situation and its nature; it may be described as heaving, thumping, slapping, undulating, or in some similar way. Its size may be expressed in terms of familiar objects—the size of a cent piece or penny, of a dollar or half-crown, of half the palm of the hand, and so forth. The situation is usually described with reference to the interspaces in which it is placed, and the nipple or axillary lines; for example, one might speak of it as being situated in the fifth and sixth interspaces extending from one inch inside the left nipple line on the right to the anterior axillary line on the left, or in similar terms. Any other pulsating area is described in a corresponding manner.

Palpation of an area of this kind may reveal a *thrill.* It is difficult to describe what a thrill is, but one may say that it is a kind of vibration which can be detected by a palpating hand. The recognition of a thrill requires practice and experience. We must observe whether it it systolic or diastolic.

Percussion.—We now proceed to examine the heart by means of percussion. (Percussion may be either direct or indirect, immediate or mediate.) Direct percussion means tapping on a part of the body with the point of a finger or with a special hammer or plessor. We hardly ever use the immediate or direct method; we nearly always employ mediate percussion, using the point of a finger of one hand as a plessor or hammer with the

intervention of the middle phalanx of the middle finger of the opposite hand applied closely to the part we are percussing. In percussing the chest the intervening finger should always be placed parallel to the ribs, not transversely. The blow or tap is delivered from the wrist, which should be quite loose and free; on no account should it be held stiffly. We may use heavy or light percussion according to circumstances.

Resonance and Dulness

If one taps on the wall of an air-containing cavity, if the wall is capable of vibration, a sound is elicited which has the peculiar character of **resonance**; it resembles that produced from a drum or any similar instrument. If, on the other hand, one taps a solid substance, or the wall of a cavity containing fluid, even if the wall is a membrane capable of vibration, the sound produced possesses no resonance and is termed **dull**: hence we have the terms dulness and resonance. An area which is very resonant—*i.e.* which produces a resounding note on percussion—is termed **tympanitic.**

We now proceed to apply this method to the heart. Percussion is usually directed here to the demarcation of the **superficial cardiac dulness** an area which corresponds to the region in front of the heart uncovered by the left lung. It is bounded above by the upper border of the fourth costal cartilage in the parasternal line, internally by the left lateral sternal line and externally by the apex beat. The upper margin curves downwards and outwards gradually to meet the apex beat, while the lower margin blends with the dulness of the left lobe of the liver, or is obscured more or less by the resonance of the stomach, according to the degree of distension of the latter. Extension of the limit of dulness to the left may signify hypertrophy of the left ventricle, retrac-

tion of the left lung, or displacement of the heart to the left owing to the presence of fluid or air in the right pleural cavity. Extension downwards usually means dilatation of the left ventricle, and, to the right, of the right ventricle. Absence of the superficial cardiac dulness may mean that the area is covered by resonant lung, as in emphysema, or that the heart is displaced inwards by air in the left pleural cavity, or it may be due to air in the pericardium. Diminution of the area may be due to similar causes. The area may be increased, generally owing to retraction of the left lung, hypertrophy of the heart, fluid in the pericardium, or tumour in the pericardium.

Auscultation.—The stethoscope is an instrument which enables us to listen to sounds in the chest—including heart-sounds—conveniently. By means of it we listen at certain areas for the sounds of the heart; if there are other or adventitious sounds present we duly note them. We do not auscultate, however, as some people appear to think, for the express purpose of finding abnormal sounds, but of ascertaining whether the normal sounds are present. We can, of course, apply the ear directly to the chest-wall, but it is much more convenient to employ some form of instrument. We listen over four places: (1) over the apex beat or *mitral area*, (2) over the second right costal cartilage or *aortic area*, (3) over the third left costal cartilage, the *pulmonary area*; and finally (4) over the junction of the sixth left costal cartilage with the sternum, the *tricuspid area*. These areas do not, of course, indicate the positions of the respective valves, but merely represent the places where the sounds characteristic of the various valves are best heard. (The pulmonary orifice is situated behind the sternum opposite the upper border of the third left costal cartilage to the left of the middle line, the aortic at the level of the

lower border of the third left costal cartilage not quite so much to the left as the pulmonary, the mitral behind the middle of the sternum at the level of the lower border of the fourth left costal cartilage, and the tricuspid obliquely behind the sternum at the level of the fourth interspace.) In order to time the various events in the cardiac cycle, especially those of an abnormal nature, it is a good plan to place the tips of two or three fingers on the carotid artery ; the carotid heave is practically synchronous with ventricular systole. When we listen, then, we note (1) whether the heart-sounds are present and whether they are distinct, (2) what their nature is —clear and sharp, booming, muffled, or peculiar in any way, (3) whether they are properly interspaced. (The beginner should now have his attention directed to the examination of a number of hearts the sounds of which are normal and properly interspaced.) If the sounds are indistinct they can sometimes be made more audible by making the patient exert himself, and it may be useful to make him stop breathing for a little if we find that the respiratory murmur is obscuring the cardiac sounds. The heart-sounds may be obscured, either the first, second, or both. If they are both absent, it usually indicates that there is much fluid in the pericardial sac ; if one of them is absent or obscure, it may be the result of disease of a valve or of weak action of the cardiac muscle. If both are obscure, it may be due to fluid in the pericardium, weak heart-muscle, or emphysematous lung.

The interspacing of the heart-sounds is of great importance. Familiarity with correct interspacing can be acquired only by listening to healthy hearts. In these the second sound follows the first after a very short interval or pause, while the second sound is succeeded by a longer pause. The sounds come thus in pairs. If they follow each other at regular intervals

like the ticking of a clock, the interspacing is abnormal and what is known as a **tick-tock** rhythm is present, indicating that the cardiac muscle is unhealthy and, in all probability, fatty. Five minutes with a stethoscope and a case in which this form of rhythm has been established will teach the student more than hours of reading.

Murmurs

A heart-sound may be accompanied or replaced by an abnormal sound called a murmur. This may be due to disease of the muscle, of the endocardium, especially of that of the valves, or of the blood itself, or to a combination of these. Occasionally it may be caused by a malformation of the heart. If a murmur is present, we must note its relation to the sounds and the events of the cardiac cycle. A murmur which occurs during ventricular systole is termed *systolic ;* one which occurs during joint diastole is called *diastolic ;* while a murmur heard in the period of auricular systole is known as *presystolic.* A systolic murmur either accompanies or replaces the first sound ; a diastolic accompanies, replaces, or follows the second sound. The presystolic or late diastolic murmur comes immediately in front of the first sound, a mid-diastolic midway between the second and first sounds, and an early diastolic just after the second sound. When we say that a murmur accompanies a sound we signify that the sound is still present, but when we say that a murmur replaces a sound we mean that the sound is no longer heard.

Having noticed the position of the murmur in the cardiac cycle we next pay attention to its **nature,** whether booming, blowing, sighing, or possessing any other special character ; it is not a point of any great importance, but it may be mentioned that the presystolic murmur of mitral stenosis is usually loud, rough, and short.

The point of **maximum intensity,** or, in other words, where it is best heard, must be taken note of, and also whether a murmur is conducted in any special direction. *Organic* murmurs are those which are due to disease of the endocardium, especially to that of the valves, and are usually heard, although more and more faintly, in some particular direction away from the point of maximum intensity, whereas those which we term *functional* and which occur without any apparent cardiac lesion are not conducted, but are confined to a very limited area.

A systolic murmur best heard in the mitral area and conducted into the axilla indicates disease of the mitral valve-cusps of such a nature as to allow a regurgitation or reflow of blood from the left ventricle into the left auricle ; the condition is known as *mitral incompetence.*

A presystolic murmur of a rough character heard over the apex beat and not conducted but confined, as a rule, to a very small area is a sign of *stenosis* or narrowing of the mitral orifice, a condition which results from previous disease of the valve-cusps and which obstructs the flow of blood from the left auricle into the left ventricle.

A systolic murmur best heard over the second right costal cartilage and conducted upwards into the neck is usually due to *stenosis of the aortic orifice* resulting from valvular disease.

A diastolic murmur heard over the second right costal cartilage and conducted downwards and inwards in the direction of the apex beat, and often best heard about the junction of the fifth left costal cartilage with the sternum, indicates that the *aortic valve is incompetent* to prevent a regurgitation of blood from the aorta into the left ventricle.

A systolic murmur best heard over the pulmonary area and not conducted is usually *functional,* and is very frequently associated with anæmia.

Systolic murmurs in the tricuspid area are, as a rule, the result of *relative incompetence.* This is not due to disease of the valve-cusps, but results from dilatation of the cavity of the right ventricle. When either ventricle loses its tone and becomes so dilated that the muscular ring at the auriculo-ventricular orifice does not contract sufficiently to allow the valve-curtains to close the opening, a certain amount of blood regurgitates back into the auricle and relative incompetence is said to exist.

There are other conditions besides those just referred to which can produce murmurs, but these need not be heeded at this stage. There is, however, a murmur which is produced not in the heart itself, but in the pericardial sac ; it is known as a *friction rub* or murmur. A murmur of this nature is often heard both during systole and diastole and is of a rough, grating character; it has no relation to respiration, although it may be simulated sometimes by a murmur of a similar nature produced in the pleural cavity. The latter, however, usually ceases when the patient holds his breath, whereas a pericardial rub does not. Occasionally this does not hold, for it is possible for a pleural rub to be evoked by the cardiac movements. In both cases the cause is inflammation of a serous membrane. The examination of the heart by means of the polygraph and galvanometer is beyond the bounds of an elementary course.

To conclude the examination the patient is made to walk rapidly up and down, if he is able, and any increase in the heart rate is noted and how soon it takes to return to its normal. The less the increase and the quicker the return to normal the wider is said to be the "**field of cardiac response,**" and vice versa. The extent of the field indicates the condition of the tone of the heart muscle. This is a matter of great importance.

CHAPTER IV

RESPIRATORY SYSTEM

SYMPTOMS POINTING TO RESPIRATORY DISEASES—SOME ANATOMICAL CONSIDERATIONS—METHODS OF EXAMINATION AND SIGNIFICANCE OF PHYSICAL SIGNS

Symptoms which might lead one to suspect that there is something wrong with the respiratory system are pain in the chest, cough, dyspnœa, and fever with wasting. We employ the same methods, in the same order, as in our examination of the circulatory system, namely inspection, palpation, percussion, and auscultation.

To enable us to apply these methods and record our results systematically, we divide the chest into certain areas or regions, which we examine according to a fixed routine. The regions in front are: (1) the **supraclavicular,** which is that immediately above the clavicle, (2) the **clavicular,** which lies just over the clavicle, (3) the **infraclavicular,** lying just below the clavicle and extending downwards to the third rib, (4) the **mammary,** extending from the third to the sixth rib, (5) the **inframammary,** lying between the sixth rib and the costal margin. The **suprasternal notch** lies at the root of the neck just above the sternum and between the inner ends of the clavicles.

At the sides are the **upper** and **lower axillary areas,** while the regions of the back are the **suprascapular, scapular, interscapular,** and **infrascapular.** These terms require no explanation, but the student should consult

for reference, books in which these areas can be seen in large diagrams at a glance.

The front, sides, and back of the chest are traversed by certain vertical lines which serve as guides in describing the condition of the respiratory system, and which enable us to record exactly the position of any abnormal physical conditions. In front the **mid-sternal line** runs vertically down the middle of the sternum; the right and left **lateral sternal** lines pass downwards at the junction of the costal cartilages with the sternum; the **mid-clavicular,** or **nipple** line, from the middle of the clavicle through the nipple, meeting the costal margin at the tenth cartilage; the **parasternal,** between the lateral sternal and nipple lines; the **anterior axillary,** running along the anterior axillary fold; the **mid-axillary,** which passes vertically downwards from the apex of the axilla; the **posterior axillary,** corresponding to the posterior axillary fold; and, finally, the **scapular** line, descending vertically through the inferior angle of the scapula.

At this stage it is a good plan for the student to revivify his knowledge of the anatomical relations of the chest generally, and of the lungs and pleuræ especially, by reference to diagrams in any of the well-known books on Anatomy, and the larger works on Clinical Medicine. He should then test whether the impressions so gathered have been accurately and firmly imprinted on his memory, by transferring them forthwith to the surface of the living body. With a little tact a student can usually get one or more inmates of a ward to allow themselves to be used for this purpose; it is well to begin early to learn to gain the goodwill and confidence of patients.

The **surface markings** of the borders and fissures of the lungs and of the limits of the pleuræ are of great importance.

The apex of the right lung is situated in the neck 1 inch above the middle of the clavicle. The anterior border may be mapped out by a line passing from the apex through the sternoclavicular junction, from which it runs downwards and inwards behind the sternum to reach almost to the middle line at the angle of Ludwig —on a level with the second costal cartilage. Passing downwards, it reaches the junction of the sixth costal cartilage with the sternum, and from there the lower border passes outwards, cutting the nipple, mid-axillary, and scapular lines at the level of the sixth, eighth, and tenth ribs respectively, reaching the vertebral column at the level of the eleventh rib. The level of the lower border, it must be noted, varies considerably according to the degree of inflation of the lung.

The apex of the left lung corresponds in position to that of the right, as does also its anterior margin as far down as the level of the fourth costal cartilage. There the line curves outwards and downwards as far as the position of the apex beat and from there to the sixth rib just outside the parasternal line. It then passes outwards at a considerably lower level than the inferior border of the right lung.

The main sulcus of either lung may be indicated by a line drawn from the second dorsal spine to the sixth rib, in the mammary line; in the case of the right lung a line drawn from the centre of the one representing the main sulcus to the sternum at the level of the fourth costal cartilage will lie over the division between the upper and middle lobes. The student having drawn these lines should note carefully the position of the apex of the lower lobe; it is the position in which physical signs indicating tuberculosis of the lung may first manifest themselves.

The bifurcation of the trachea corresponds in front to

the lower part of the *manubrium sterni* and behind to the disc between the fourth and fifth dorsal vertebræ.

The inferior border of the pleural membrane reaches a considerably lower level than that of the lung, being 2 inches below it in the mammary, 4 inches in the mid-axillary, and 1½ inches in the scapular lines.

Methods of Examination

I. **Inspection.**—We should begin by looking at the front of the chest, then the axillæ, and finally at the back. If possible, the patient should be lying on his back with the chest uncovered, and his arms by his sides, in a good light. The physician should sit or stand looking towards the patient's face. He observes the **nature of the breathing,** whether rapid or slow, easy or laboured; whether costal, abdominal, or costo-abdominal. The **type of chest** is of importance. Is it well formed and does it conform to the type of a healthy thorax? If it does not, then is it of any special shape? A **box-** or **barrel-shaped chest** is one in which the antero-posterior diameter is approximately the same as the lateral; a **pigeon breast** is one in which the sternum is thrown far forwards, while the ribs, from the angles forward, tend to become straight instead of curved; a **flat chest** is one in which the antero-posterior diameter is much diminished; and an **alar type** is a flat chest in which the scapulæ project like wings. A **rickety** chest presents a vertical depression on either side of the sternum, and a horizontal depression above the upper margin of the liver.

Is the chest symmetrical or is there any special bulging or retraction? Bulging on one side may be present in cases of empyema, pneumothorax, and pyo-pneumothorax, or in a unilateral emphysema; retraction may follow a cured empyema or occur as the result of

tuberculosis. The degree of bulging or retraction may be slight or very great.

To examine the back the patient is made to sit up, if he can, with his arms crossed on his chest or with a hand on each knee and leaning slightly forwards. The physician sits or stands facing the back of the patient. If the patient is very ill, we must do the best we can with him in the recumbent position.

(It is best, of course, to complete the examination of the front of the chest and axillæ, from inspection to auscultation, before proceeding to examine the back, and, in taking notes, the student should first give a complete description of the condition of the front of the chest on inspection, palpation, percussion, and auscultation, then of the axillæ and, finally, of the back. Systematic examination of this nature is not a superfluous proceeding, but is absolutely necessary if we are to avoid mistakes.)

We note next **whether the chest is well covered** with muscle and subcutaneous fat, or whether the ribs and clavicles are more prominent than is usual.

The nature of the movement of the chest is of importance. Is there any movement? Is it heaving or expansile, and is it equal and synchronous on both sides? The movement of a healthy chest is expansile, but it may acquire a heaving nature owing to senile changes or emphysema having lessened the elasticity of the thoracic wall. **Delayed or diminished movement,** or both, on one side, may be due amongst other things to pulmonary tuberculosis, empyema, or pneumothorax.

II. **Palpation.**—We next employ palpation. This consists of two parts:

(1) Palpation of movement;

(2) Palpation of the vocal fremitus.

Palpation of Movement.—We palpate to find out if there is any **movement,** what its nature is (expansile or heaving), and whether it is **symmetrical** and **synchronous.** First, with the thumbs touching in the middle line over the *manubrium sterni,* the palms of the hands and palmar surfaces of the fingers over the clavicular and infraclavicular regions, the points of the fingers being in the supraclavicular fossæ, we ask the patient to breathe deeply and to continue to do so. The movement here is not to any great extent of an expansile nature.

Next, with the thumbs together in the middle line of the *gladiolus,* with the palms of the hands over the mammary regions, and the fingers in the axillæ, we ask the patient to continue to take deep breaths, and, further, we repeat this with the thumbs over the ensiform cartilage and the palms and fingers over the inframammary regions. Finally, we proceed to examine the back in a similar way, taking the suprascapular, scapular, and infrascapular or basal regions in succession.

The object of having the thumbs in the middle line is to find out if there is expansion taking place and to estimate the symmetry or asymmetry of it.

The **vocal fremitus** next claims our attention. By vocal fremitus we mean the vibrations which are communicated to the palpating hand when the patient speaks. These sound-vibrations are produced in the larynx, and are re-inforced and expanded in the resonating chambers of the pharynx, nasal cavities, larynx, trachea, and large bronchi, and are carried through the air-tubes and sacs to the chest-wall where they are communicated to the palpating hand. The healthy lung is not a particularly good conductor, but it is better than fluid in the pleural cavity. If, then, the pleural cavity contains fluid, the transmission of the vibrations is

interfered with; and if there is air in the pleural cavity, and the lung is collapsed, naturally, as air is not a good conductor in itself, the passage of vibrations is interrupted, and they are not well felt by the palpating hand. On the other hand, solid material, such as solidified lung, conducts well, so that, if a lung is in a condition of pneumonic or any other kind of solidification, the vibrations are conveyed more readily to the wall of the thorax and the palpating hand than they are by healthy lung-tissue and are more distinctly felt.

We notice whether the vibrations are present and whether they are the same or different on the two sides. It is not right, as a rule, to say that the vocal fremitus is increased or diminished; it is more correct to state that it is better or not so well felt, or absent on one side compared with the other. Thus we might say that the vocal fremitus is more distinctly felt at the right basal region than at the left, or that it is present, let us say, on the right but absent on the left side. We should not say that it is diminished on the left or increased on the right side.

III. **Percussion.**—Here we employ the same method as in the examination of the heart, but the area is more extensive. We begin by percussing the supraclavicular region on either side, the clavicular, infraclavicular, and so on. We use direct or immediate percussion over the clavicle, but elsewhere we use the middle finger of the non-percussing hand as a plexímeter. The finger which is being struck must be held flat on the chest and parallel to the ribs, as described under the circulation.

We must always bear in mind, in percussing the chest, that we are comparing the two sides. We, therefore, note whether one side is less resonant than the other. The resonance may be increased on one side or diminished on the other, but, as we have seen in discussing vocal

fremitus, we do not employ the terms increased or diminished, but merely state that the resonance is greater or less, as the case may be, on one side than on the other. What may be the normal resonance for one person may not be normal for another. If, however, an area is absolutely devoid of resonance, we may dsecribe it as dull on percussion, and, on the other hand, if there is very marked resonance anywhere, we may say that it is hyper-resonant or tympanitic.

We percuss the axillæ and the back in a similar way, working from above downwards and comparing the corresponding regions of the two sides.

Dulness or loss of resonance may be produced by solid lung or fluid in the pleural cavity, or by great masses of fibrinous exudate or thick fibrous adhesions in the pleura, with a certain amount of collapse of lung. Hyper-resonance may be elicited over a large pulmonary cavity, over a pneumothorax, or over an emphysematous lung.

IV. **Auscultation.**—The breath-sounds, which we hear on listening over the air-passages and lungs, are produced at the nose or mouth and at the *rima glottidis*, They are magnified in the resonating chambers of the nose, pharynx, larynx, trachea, and large bronchi in the same way as the vibrations causing the vocal fremitus are, and are conveyed through the air-passages to the chest-wall, being modified and damped on their way through the air-vesicles.

If you listen over the trachea in the suprasternal notch you will hear two sounds, the inspiratory and the expiratory. They are equal in length, are high-pitched, and there is an interval between the inspiratory and the expiratory murmur. This is **tracheal breathing.** If, now, you listen over the spine at the level of the fourth dorsal vertebra, you will hear the same kind of sound, but less loud and clear and rather less high-

pitched ; there is still an interval between the inspiratory and expiratory murmurs, which are of equal duration. That is **bronchial breathing.** Listen next just below the clavicle in a healthy individual, and you will notice that the respiratory murmur has become considerably modified. It has a sighing instead of a blowing nature, the expiratory is shorter than the inspiratory sound, there is no interval between the inspiratory and expiratory murmur, and the pitch is low. This is known as **vesicular breathing.**

Bronchial breathing is, then, really modified tracheal breathing, and there are several varieties of it. If it is very loud, clear, high-pitched and distinct, it is known as **tubular breathing.** If the sound resembles that produced by blowing over the mouth of a wide-necked bottle, it is called **amphoric** or **cavernous ;** it is heard over cavities.

Imagine the ordinary lung-tissue replaced by solid material which carries sound well ; you can conceive how the respiratory sounds will no longer be modified by the vesicular pulmonary structure, but will be carried straight from the bronchi, practically unchanged to the chest-wall. You will understand why bronchial breathing is heard over solid lung ; indeed it may be tubular if the consolidation is massive and the sounds are carried direct from the larger air-tubes to the chest-wall.

On the other hand, when the lung-tissue is replaced by a cavity, and if the cavity communicates with a bronchus, we should also hear bronchial breathing of a modified nature, the sound being conveyed from the bronchus to the cavity, where it is resonated and modified, and conducted to the chest-wall as amphoric or cavernous breathing.

Should the lung be compressed by fluid or air in the pleural cavity—both of which are bad conductors of

sound—the breath-sounds will not be conveyed from the lung to the chest-wall on account of the presence of the unfavourable conducting medium, or, if they are conveyed, they will be carried only faintly.

We must next listen for the **vocal resonance.** On auscultating over the various areas of the chest while the patient says "ninety-nine," "one, two, three," or some such phrase, we hear a sound which is known as the vocal resonance. We cannot usually clearly distinguish the words spoken. Here, again, the sounds are produced at the *rima glottidis*, resonated in various chambers, and conducted along the bronchi and through the lung substance to the chest-wall, being modified on their way by the walls of the alveoli. If the lung is in a condition of solidification the voice-sounds are conducted directly from the bronchi to the thoracic wall. We may then hear the actual words spoken; this is known as **bronchophony.** If there is a large cavity, or a small cavity close to the surface, we may hear the words uttered by the patient when he whispers. (It is very difficult to get native patients of the coolie class to whisper.) This phenomenon is known as **pectoriloquy.** If there is air or fluid in the pleural cavity, or if one of the main bronchi is blocked up, the voice-sounds are absent or are heard only faintly. In some cases of pleural effusion, at the level of the upper part of the fluid, the voice may have a nasal character and resemble somewhat the bleating of a goat; this is called **ægophony.**

Adventitious Sounds

In the first place, we may hear a rough, grating sound, more especially at the bases and in the axillæ. It is known as a **pleuritic rub or murmur**, and is produced by

the rubbing of two inflamed pleural surfaces against each other.

In the lungs themselves there may be produced moist and dry **adventitious sounds.** Moist sounds may be extremely fine or very coarse, and there are all sorts of intermediate types. The finer sounds are produced in smaller bronchi and alveoli which contain moisture. The large, coarse, moist sounds are met with in cavities and the large bronchi. **Moist sounds or crepitations,** as they are also called, are of a crackling or clicking nature, and must be listened to many times before we can become familiar with them ; on that account students should take the opportunity of listening to as many cases as possible in which adventitious sounds are to be heard. They are probably caused by the entering air separating moist surfaces or bubbling through fluid. One also notices whether they occur during inspiration, expiration, or both, and whether they are heard during the whole of the phase or only at the beginning, middle, or end.

Dry sounds or rhonchi are produced in the bronchi, usually in the medium or large tubes. They may be of a squeaking or whistling type—sibilant—or of a rough, snoring nature—sonorous. They are usually associated with inflammation and swelling of the bronchial mucosa. The precise mode of their production is very difficult to explain, and it is impossible to describe them exactly. To become thoroughly acquainted with them assiduous practice is necessary, and in order that familiarity may be obtained with the various signs as many cases of bronchitis and other pulmonary diseases should be examined as possible.

It is always desirable in cases where you suspect the lung to be affected to make the patient cough and then breathe deeply, listening over the doubtful area the

while. In this way you may often elicit adventitious sounds which would otherwise escape your notice.

"Cracked Pot sound."—This is produced by percussion over large cavities in the lung which communicate with a bronchus through a narrow opening. During percussion the patient is told to open his mouth. The sound is like that produced by clasping the hands tightly and knocking them on the knee. It is of little importance.

Signs of Consolidation of the Lung

Inspection.—Probably some impairment of movement.

Palpation.—Diminution of expansion; vocal fremitus more distinct over affected area than elsewhere.

Percussion.—Dulness or, at least, impaired resonance.

Auscultation.—Bronchial or tubular breathing and bronchophony. There may or may not be moist sounds.

Signs of Fluid in the Pleural Cavity

Inspection.—Impairment of movement and perhaps bulging of the affected side, and even bulging of the intercostal spaces.

Palpation.—Diminished movement and vocal fremitus either absent or much diminished.

Percussion.—Impairment of resonance or dulness.

Auscultation.—Breath-sounds absent or feeble and vocal resonance absent or faint; perhaps there may be ægophony.

Signs of Air in the Pleural Cavity

Inspection.—Bulging of affected side and probably of the intercostal spaces; impaired movement.

Palpation.—Impaired movement; vocal fremitus absent or faint.

Percussion.—Hyper-resonance.

Auscultation.—Breath-sounds absent or feeble—vocal resonance absent or only faintly heard. We also get the **bell-sound.**

To elicit the bell-sound you listen over the front of the chest, with the patient in a sitting posture or lying on his side, while an assistant places a coin flat on the back of the same side and taps it with the edge of another coin. A clinking sound is heard instead of the dull tap which is heard usually.

If there is fluid as well as air, on shaking the patient and listening over the base of the affected side, either with the stethoscope or with the ear directly applied to the chest-wall, a splashing sound is heard. This is known as **Hippocratic succussion** or **succussion splash.**

The examination of the chest by X-rays has become of great importance of recent years, but this method is one which is of value only in the hands of specialists and is outside the scope of this work.

CHAPTER V

DIGESTIVE SYSTEM

ANATOMICAL RELATIONS—SYMPTOMS—METHODS OF EXAMINATION

Some Anatomical Relations

The anterior aspect of the abdomen has been arbitrarily divided into nine regions by two vertical and two horizontal lines. The vertical lines pass straight upwards on either side of the median line from a point midway between the anterior superior spine of the ilium and the middle point of the upper border of the symphysis pubis. The upper horizontal line crosses the body at the level of the lower borders of the tenth costal cartilages and the lower joins the two anterior superior spinous processes of the ilium. The areas thus formed are, from above downwards, on the right, the right hypochondriac, lumbar, and iliac; in the middle, the epigastric, umbilical, and hypogastric; on the left, the left hypochondriac, lumbar, and iliac. This division enables us to indicate conveniently the position of pain, tumours, and other points of importance. The student with a good, clear diagram by him should map out these areas on the body of a patient, and mark in the chief organs corresponding to each area.

The following important relationships of organs or

structures to the surface of the body should be kept in mind.

Liver.—The summit of the dome of the right lobe really reaches as high up as the fourth right interspace in the nipple line, but the actual levels at which it touches the chest-wall, above, are the sixth, eighth, and tenth ribs, in the nipple, mid-axillary and scapular lines respectively. The lower border passes across from the ninth right to the eighth left costal cartilage.

Gall-bladder.—The apex of this structure lies at the angle between the ninth right costal cartilage and the outer border of the right rectus abdominis muscle.

Stomach.—The cardiac orifice lies deeply behind the seventh left costal cartilage, 1 inch from the sternum. The situation of the pyloric orifice varies somewhat according to the state of distension of the stomach. A transverse line midway between the symphysis pubis and the suprasternal notch is called the transpyloric plane ; the pylorus lies on this plane in the middle line when the stomach is empty, and an inch or more to the right when the organ is full. The lesser curvature may be represented by a line joining these two points, but the greater curvature varies its position with the condition of the organ.

Pancreas.—This organ lies across the front of the vertebral column behind the stomach in the lower part of the epigastric region.

Appendix.—The orifice is situated 2 inches below the middle of a line joining the right anterior superior spine of the ilium and the umbilicus, but pain and tenderness caused by inflammation of the organ are felt at McBurney's point, a spot midway between the anterior superior spine and the umbilicus.

The **cæcum** lies in the right iliac and hypogastric regions.

The **ascending colon** is found ordinarily in the right lumbar and hypochondriac regions, and the **transverse portion** of the large intestine passes across the upper part of the umbilical region to the left hypochondrium, but the position of these structures varies greatly in different persons ; examination by means of X-rays and bismuth meals has thrown much new light on this subject. The **descending colon** passes from the left hypochondriac down through the left lumbar to the left iliac region, where it becomes the **iliac colon** which is in the hypogastric region.

The **duodenum** is situated in the epigastric and umbilical areas, while the rest of the **small intestine** corresponds in position to the part of the abdomen within the boundaries of the large intestine.

The **spleen** corresponds in its long axis to the ninth, tenth, and eleventh ribs, and the anterior pole should not come further forward than the mid-axillary line.

Kidneys.—The lower pole comes as far down on the front of the body as a line drawn transversely between the lower borders of the tenth costal cartilages.

The **bladder**, in a state of moderate distension, rises into the hypogastrium, and when greatly distended may reach as high as the umbilicus.

The **uterus**, normally situated in the pelvis, may, when diseased, become an abdominal organ, and the pregnant uterus does so about the third month.

There are certain symptoms which would draw your attention to the digestive system particularly, such as pain or discomfort in the abdomen, nausea and sickness with vomiting, constipation, diarrhœa, or alternate diarrhœa and constipation, and difficulty in swallowing.

With regard to symptoms such as pain and vomiting, we should ascertain whether they have any relation to the taking of food. Some conditions, such as gastric

ulcer, may be aggravated by food, while others, such as the " hunger " pain of duodenal ulcer, are relieved by it.

Vomiting may occur immediately after food is ingested, or, again, it may not happen till some time after a meal; indeed, in dilatation of the stomach it takes place, as a rule, at intervals of days.

Another symptom which would lead us to take particular care with this system is difficulty of swallowing, or dysphagia, especially if there is no manifest cause for it. Wasting, also, for which no definite cause can be found, will especially attract our attention to the digestive system, since obscure malignant disease in the abdomen may cause grave emaciation.

On proceeding to carry out a routine examination, you would first ask to see the **tongue and the teeth.** In some conditions the tongue may give a certain amount of information, *e.g.* in typhoid fever, where it is dry and coated in the centre and red at the tip and edges. The teeth may be deficient or bad, and may give rise to trouble, owing to the food being insufficiently masticated; or the patient may be suffering from a purulent condition of the gums known as *pyorrhœa alveolaris,* which causes various symptoms.

With a proper depressor, or, in an emergency, some other suitable flat instrument, the back of the tongue is pressed downwards so as to obtain a good view of the back of the throat. Any enlargement of the tonsils or any redness or swelling of these or of the pharynx, or any other abnormalities, are noted; in children this part of the examination is left to the very last.

Can the Patient swallow Solids or Liquids?

This point can be settled easily by giving the patient milk or water to drink or some solid food to swallow.

You should not, as a rule, take a patient's word for the ability of his œsophagus to carry the food to the stomach.

You then proceed to investigate any special symptoms, such as **pain.** Wherever there is pain, whether in the abdomen or elsewhere, there are certain principal points to consider. Is the pain general or localised? What is its nature; is it sharp and stabbing, or dull and gnawing? Is it constant or intermittent? Is it made better or worse by pressure? Is it relieved by vomiting? In some cases vomiting will bring relief—*e.g.* in gastric ulcer—whereas in others it has no such effect, in renal colic, for example. Is it followed by diarrhœa? In many cases of catarrh or inflammation of the intestinal mucosa, especially of that of the large intestine, pain is followed and relieved by diarrhœa. Does it travel in any special direction, as in renal colic?

Nature of the Motions

These may contain blood. If the blood is fresh, it will be of a bright red colour; if it has been delayed in the intestine for some time it will be black, giving the stool what is called a "tarry" appearance: the black colour in this case is due to the presence of sulphide of iron. In amœbic dysentery the patient's motions usually contain a mixture of blood and mucus. Rice-water stools are colourless, watery stools with flocculent masses floating in the liquid part, like water in which rice has been boiled; they are characteristic of cholera. Colourless, solid stools having the appearance of white clay are found in obstructive jaundice. Typhoid stools are of a pea-soup nature or of a bright yellow colour. The stools of children and of persons on a milk diet are pale yellow.

The next proceeding is the physical examination of

the abdomen, and here, again, we commence with **inspection.**

The patient is placed on his back in a good light and, at first, with the legs extended. In some cases he lies with one or both legs flexed, either from necessity or choice, the right leg in appendicitis and both legs in peritonitis.

The observer faces the patient and notes the general appearance of the abdomen. The abdominal veins may be very prominent and distended, as in cases of cirrhosis of the liver; the abdomen may be distended, and, if it is, attention should be paid to the position of the distension, whether it is specially marked in the flanks or elsewhere. **Distension** may be due to flatus, fluid, fæces, fœtus, or tumours of the ovary, uterus, or other organs, and may be simulated by fat in the abdominal wall.

The abdomen may show **retraction.** The term "scaphoid" is applied to a greatly retracted abdomen such as is seen in cholera or in conditions leading to great emaciation, *e.g.* chronic dysentery.

We must note whether the abdomen is symmetrical or whether there is any special protuberance. If there is a localised swelling, its site and size are observed and one notes also whether it moves or is stationary during respiration.

The next point is: **Does the abdominal wall move during respiration?** Normally, of course, it does so, but in cases of paralysis of the diaphragm or general peritonitis there is no movement.

Palpation of Abdomen

Remember that the peritoneum is a delicate structure; both it and the organs which it covers resent rough

manipulation or sudden shocks, and, to protect them, there is a mechanism known as the **viscero-motor reflex** which is rendered more sensitive if any of the abdominal organs or the peritoneum are diseased, especially if the condition is an acute one. If the hand be placed roughly on the abdomen the wall immediately contracts ; this is the manifestation of the viscero-motor reflex, and, if an abdominal organ such as the appendix or the gall-bladder be inflamed, even light touch by the hand will elicit a marked contraction of the overlying muscle. An afferent impulse passes from the viscus to the spinal cord and thence to the muscle or muscles supplied from the same segment or segments of the cord. In examining the abdomen, then, we must use light touch with a warm hand ; a cold hand provokes the viscero-motor reflex very readily. Lay the flat hand gently on the abdomen over the left iliac region and then, in turn, over the hypogastric, right iliac, right lumbar, umbilical, left lumbar, left hypochondriac, epigastric, and right hypochondriac, the patient, meanwhile, being exhorted to breathe deeply and regularly. You must observe whether the abdominal wall is held rigidly or loosely and whether there is any contraction of the abdominal muscles when the hand is applied, or, in other words, whether there is an excessive activity of the viscero-motor reflex ; and, at the same time, you should watch the patient's face, because it may give a clue to whether pain is felt on abdominal palpation and pressure. Pain on pressure is usually known as "tenderness." If there be any dubiety as to what is felt in any particular region, then deeper and more forcible palpation must be employed, but it ought not to be in any way rough. Do not use the points of the fingers ; the hand must be laid flat on the abdomen. Students should remember that it is wrong to dig the fingers into the abdominal

wall, and that if they really want to ascertain the condition of the organs in the abdomen, they are unlikely to do so unless their manipulation is carried out in a gentle manner.

Does the hand detect any special protuberance or swelling? If there be any swelling or tumour felt, the following points should receive attention: (1) Size; (2) shape; (3) position; does it, roughly, correspond to the place occupied normally by any special organ or structure? (4) Its margin; is it well defined or indistinct? (5) Is the swelling in the abdominal wall or in the cavity? By making the patient attempt to raise the trunk from the recumbent position without using his hands you will induce the muscular wall to become tense, so that if the swelling be in the abdominal cavity it will no longer be felt, but if it be in the wall it will still be palpable. (6) Is it movable? If so, can it be moved freely or only with difficulty? (7) Does it move with respiration? (8) Is it tender? (9) Can any fluctuation be detected? (10) Does it tend to retire to any particular region when pressed on? (11) What kind of consistence has it—hard or soft; does it feel smooth or nodular? (12) Is there any pulsation? (13) Is there a thrill to be felt over it? (14) Is there any peristaltic movement over it?

To complete the palpation of the abdomen one should always examine the spleen and liver, and particularly is this the case in the tropics. In examining the splenic area one sits or stands on the right hand of the patient. The left hand is placed under the costal margin in the left lumbar region and is pressed forward firmly. The right hand palpates from the hypogastrium upwards till the left costal margin is reached. If a swelling be felt, one endeavours to ascertain whether it resembles the spleen in its shape, whether it can be moved between

the hands, and whether the splenic notches can be detected.

In examining the hepatic region one reverses the position. Sitting or standing on the left of the patient, one places the right hand posteriorly in the left lumbar region below the costal margin, pressing firmly on the abdominal wall with the left hand, which is moved gradually upwards from about the umbilicus to the right costal margin. Another method is to sit on the right side of the patient and, placing the palmar surfaces of the fingers of the left hand posteriorly in the right lumbar region below the costal margin, to press them forwards and to palpate with the right hand from below upwards from the right lumbar and umbilical regions towards the right costal margin. The lower margin of the liver passes from the ninth right to the eighth left costal cartilage, and is not usually palpable in adults.

If we suspect the presence of free fluid in the cavity, we should examine for the presence of a **transmitted thrill.** One places the palm of the left hand over the left lumbar region and taps sharply with a finger in the right lumbar. A series of vibrations is conducted to the left hand if there be a sufficient amount of free fluid present. To prevent the vibrations from passing over the abdominal wall in obese people, we get someone to place the edge of an open hand on the abdomen vertically while the manipulation is being carried out.

If we suspect that there is dilatation of the stomach, we may try to elicit a splashing sound by sudden and forcible palpation. Using in this case the finger-tips more than the flat of the hand, we can employ both hands, one being pressed steadily over the stomach while the other is employed in making forcible, sudden palpation.

Percussion of Abdomen

We now proceed to percuss the abdomen, using the same methods as detailed in the examination of the chest, proceeding from one region to another in the order followed in abdominal palpation, and observing whether there is resonance all over the abdomen or whether there are areas which are less resonant or even dull. Particular attention should be paid to the percussion note over any swelling or protuberance. Another point we must notice in cases where we suspect the presence of free fluid is whether shifting dulness can be detected. Usually, if there be free fluid in the abdomen, when the patient lies on his back there is dulness in the flanks, which disappears from the higher area when the patient lies on one side, while the dull area is increased on the dependent side.

We now proceed to percuss the spleen and liver areas. The spleen lies along the line of the ninth, tenth, and eleventh ribs, and its anterior pole should not come farther forward than the mid-axillary line. In percussing for the splenic dulness we commence about the level of the sixth or seventh rib on the left side, just anterior to the mid-axillary line, and percuss downwards till we reach the costal margin. If we find resonance throughout, the spleen is not enlarged, but, should we find dulness in front of this line along the ninth, tenth, and eleventh ribs, extending forward towards the costal margin and upwards to the seventh or eighth rib, we must consider that the spleen is larger than it ought to be.

The percussion of the upper margin of liver dulness is the next point. One must remember that the dome of the right lobe reaches a considerably higher level than the limits of dulness would indicate. The upper limit of dulness corresponds, practically, to the level of the

lower limit of the pulmonary resonance, and may be placed at the sixth, eighth, and tenth ribs in the nipple, mid-axillary, and scapular lines respectively. In mapping it out we percuss from above downwards in these lines and mark the upper level of dulness. We then join these points by a transverse line, which gives the upper border of the liver dulness. Percussion of the lower margin of the liver dulness is a matter of considerable difficulty, owing to the adjoining resonance of the stomach and transverse colon, and, therefore, for the detection of the lower margin, we rely more on palpation than percussion. The breadth of liver dulness, which in the nipple line should be about $4\frac{1}{2}$ inches from above downwards, may be found to be **normal, obliterated, diminished,** or **increased.** It may be **obliterated** by free gas in the peritoneal cavity or by abnormal distension of the colon by gas. It may be **diminished** (1) by factors acting from above—pneumothorax or emphysema on the right side ; (2) by factors acting from below—over-distension of the colon or stomach with gas ; (3) from decrease in size of the liver itself, due to atrophic cirrhosis, perihepatitis, or acute yellow atrophy.

It may be *actually* or only *apparently* increased. An **apparent increase upwards** may be due to extraneous factors acting from above—solidification of the right lung or fluid in the right pleural cavity ; in the case of the left lobe it may be due to similar causes and in some cases to fluid in the pericardium. An **actual increase** is brought about by pathological conditions; chronic venous stasis, abscess, cholangitis, waxy disease, malaria, syphilis, rickets, and hydatid cysts.

Apparent displacement downwards of the lower margin may be produced (1) by factors acting from above —pneumothorax, empyema, massive consolidation of right lung or subdiaphragmatic abscess ; (2) any of the

above factors mentioned as producing actual increase in size of the liver ; (3) the condition known as Glenard's disease in which there occurs a general sinking-down of the abdominal organs, another term for it being gastro-enteroptosis ; (4) a malformation of the liver in which a piece of the right lobe projects down below the costal margin—Riedel's lobe.

An **enlarged** or **distended gall-bladder** gives rise to a localised area of dulness projecting from below the costal margin under the right rectus muscle ; it is very often associated with marked tenderness and an active viscero-motor reflex.

The chemical examination of the stomach contents after a test meal, the X-ray examination after a bismuth or barium meal and that of the fæces for "occult" blood and other substances, should be put into the hands of recognised experts ; they are beyond the powers of the ordinary medical practitioner and grievous harm may result from relying on the statement of the class of persons whom one may term amateur or inexpert experts.

CHAPTER VI

NERVOUS SYSTEM

SYMPTOMS—GENERAL CONSIDERATIONS—EXAMINATION

THE following are symptoms which would lead us to devote our attention to the nervous system specially: loss or impairment of muscular power; local muscular wasting; muscular tremors; loss, impairment, or perversion of sensation; persistent pains, especially of a shooting character, in limbs; feelings of constriction or of a "girdle" pain round the trunk; difficulty in walking, from no obvious cause; giddiness, persistent headache; impairment of speech; fits.

The structure of the nervous system is so complex that we constantly need to consult books of reference when dealing with cases of nervous diseases, and especially if we meet with these only rarely, but we should easily retain a mental picture of the principal points, such as the general nature and relations of the chief parts of it. It must be remembered that this system consists of an enormous number of neurones—nerve-cells and their processes—all locked together to form series of paths, connecting different parts of the brain and spinal cord or forming connections with the periphery. The student must remember the more important of these, and what happens if any of them are interrupted.

The **peripheral nerves** should be regarded as parts of

the great sensory and motor paths to and from the cerebral cortex ; the spinal cord, it must be recognised, consists partly of these paths gathered into more or less definite tracts, and partly of masses of cells, some of which are transmission stations on these paths, while others are centres for spinal reflexes. Should a focus of disease be set up in the spinal cord, or should it be the seat of injury, the symptoms which result will depend on the level at which the disease or injury is situated. The cervical and lumbar enlargements are the two principal collections of cells concerned in reflex action, the latter being of more consequence, since the centres for the control of important organs, such as the bladder and rectum, lie here. The condition of the reflexes gives valuable information regarding the site of a lesion affecting the cord, and, in examining the nervous system, the student should have by him a good diagram to which he can refer for the level of the centres, as he tests the reflexes. It will be found by far the best plan in a case of suspected nervous disease to collect all the information to be obtained by thorough examination, and, having taken full notes, to study these closely with constant reference to books dealing with the structure, functions, and derangements of the nervous system.

The motor and sensory paths through the brain are continuations of those through the cord, to and from the peripheral nerves, as we have already seen, and, consequently, any method of examination applied to the cord or peripheral nerves will also apply to the corresponding tracts in the brain.

The base of the brain and the important centres situated there give rise to the **cranial nerves,** and, therefore, an examination of these will give us important information regarding the condition of the medulla, pons, and other parts of the brain situated there ; not

only so, but those of them that are connected with special senses may tell us much about the condition of the cerebral cortical areas in which the higher centres for these senses are situated.

The state of the cortex will be revealed partly by the examination of the motor and sensory functions, the condition of which will show that of the cortical motor and sensory areas; the examination of the special-sense cranial nerves will aid us with the cortical areas concerned with those senses, as we have seen; the condition of the speech, memory, and intelligence will also guide us in our estimate of the state of the cortex.

The student will now proceed to take notes on the condition of the different parts of the nervous system as brought out by his examination. These are, then, (1) the **peripheral nerves,** (2) the **spinal cord,** and (3) the **brain.** By examining the peripheral nerves we ascertain whether they are conveying their efferent and afferent impulses properly. We deal first with the efferent type, and, naturally, as these supply muscles, mainly, an enquiry into the muscular power will disclose to us whether the efferent impulses are passing freely to the muscles, or, in other words, whether the efferent nerves are healthy or not.

Motor Functions

We begin from below and work upwards. First, we get the patient to flex and extend the toes against resistance, then the foot, the leg, and the thigh on the right and then on the left side, in every case applying resistance by the hand. Next, we proceed to examine the upper limbs in the same way, making him exert his hand grip, flex the fingers, the hand, the forearm, and the upper arm on the right and left successively, against resistance. Finally, we make him rise from a recumbent

to an erect position, as far as possible without the assistance of his hands, and nod the head. If all these movements are performed without difficulty, we know that the muscles and their nerves are in a healthy condition.

The following terms are used in connection with the peripheral nerves: (1) **paresis**—weakness of a group or groups of muscles due to disease of nerves; (2) **paralysis**—complete loss of function of a group or groups of muscles due to nervous causes; (3) **monoplegia**—paralysis or paresis of one limb; (4) **hemiplegia**—paralysis or paresis of one side of the body; (5) **paraplegia**—paralysis or paresis of both sides of the body, usually of the lower limbs only; (6) **anæsthesia**—loss of sensation, partial or complete; (7) **paræsthesia**—perverted sensation in which stimuli produce effects different from those which are the normal response; (8) **hyperæsthesia**—increase of sensibility to normal impulses.

Sensory Functions

The condition of the sensations will give us a clue to the state of the afferent nerves. We test, first, the sensation of **light touch** by means of a piece of cotton wool or some similar substance. With this we touch the patient from the sole of the foot upwards, alternately on the right and left sides, and ask him to say where he feels it. The patient should not be allowed to see what is being done, but should be instructed to close his eyes, and, if necessary, should be blindfolded. Do not press on the patient's skin, but touch it very lightly and note any areas where there is anæsthesia, hyperæsthesia, or paræsthesia.

To ascertain whether the sensation of **pressure** is present we press firmly with some blunt body on the surface on both sides, alternately, and ask whether the

patient feels it. In the same way by means of a pin or some similar sharp instrument we test the sensation of **pain.**

By means of a test-tube of hot and one of cold water the sensations of **heat** and **cold** are tested; the patient is instructed to say "hot" or "cold," according to the nature of the sensation felt, and the plan followed is that used in testing touch and pain.

Incidentally, while ascertaining the conditions of the motor and sensory nerves, we find out, at the same time, whether the conducting function of the cord is intact or impaired.

Reflexes

The condition of the nerve centres is indicated by that of the reflexes—superficial, deep or tendon, and visceral.

Superficial Reflexes

The first of these is the **plantar.** For the purpose of examining this, the patient is placed in the recumbent position with the leg everted and slightly flexed. With the head of a pin, the end of a pen-holder, or some similar blunt instrument the outer part of the sole of the foot is gently stroked. The response should be a flexion of the toes. In native patients of the coolie class the epidermis of the sole of the foot is usually so thick and horny that the efferent impulse is not transmitted, and the response, therefore, does not occur, although no disease is present. In cases of *sclerosis of the lateral columns* the response is somewhat different, the great toe being extended while the others are flexed. This is known as the extensor response or *Babinski's sign.* It also occurs in infants before the cord is myelinised.

The **cremasteric reflex** is elicited by scratching or stroking the skin of the upper part of the thigh, and the response is a contraction of the cremaster muscle with elevation of the testicle.

The **umbilical reflex** comes next. The stimulus is applied by stroking the skin just outside the outer margin of the rectus muscle at the level of the umbilicus, and the response is a contraction of the rectus at that level.

The **epigastric reflex** is elicited by stroking or scratching the skin of the lower part of the axilla, the response being a contraction of the rectus in the epigastrium. It may also be excited by scratching the skin in the epigastrium.

The **palatal reflex** will be referred to under the cranial nerves.

Deep or Tendon Reflexes

The first of these is the **knee jerk.** If he can do so, the patient should sit up with one leg over the other knee, the foot and the leg being allowed to hang loose. The observer then grasps the leg to be examined, above the knee, with the left hand, to detect any movement of the quadriceps muscle when the stimulus is applied to the tendon. (If the patient will not allow the leg and foot to hang loosely, he should be told to interlock the fingers and pull, and at the same time to look at the roof. This distracts his attention and is known as *reinforcement*.) The patellar tendon is then smartly struck with the points of the fingers of the right hand, and the response is a quick, forward jerk of the foot.

The knee jerk may be *absent*, and this may be due to a lesion of the centre in the cord or of the afferent or efferent nerves. On the other hand, it may be *exaggerated*, and this is due, amongst other conditions, to sclerosis of the lateral columns of the cord.

We next examine for **ankle clonus.** This condition is not present in healthy people. It is elicited by grasping the leg of the patient with the left hand just above the ankle, while the right hand grasps the ball of the foot and jerks it smartly upwards in a position of extreme dorsi-flexion. The tendo Achilles is thus put suddenly on the stretch, and the response is a series of clonic contractions. The leg should be slightly flexed at the knee while the test is being applied. The contractions should continue to occur as long as the tendo Achilles is kept tense. In some cases a few jerks ensue on applying the stimulus, but unless they continue to occur we cannot say that ankle clonus is present. It has, in many cases, the same meaning as an exaggerated knee jerk and is associated with Babinski's sign. It is, therefore, significant of a lesion of the upper motor neurones.

The **Achilles jerk** may be obtained by steadily pressing the foot upwards in a position of extreme dorsi-flexion and tapping on the tendon ; the foot is pushed forward.

The **wrist reflex** is elicited by supporting the arm and allowing the hand to hang down and striking the extensor tendons sharply. The hand is jerked upwards.

The **supinator reflex** may be demonstrated in a similar way, the stimulus in this case being applied to the tendon of the supinator longus.

The **triceps jerk** is tested by flexing the arm at the elbow to make the tendon tense, and then tapping on the tendon, while the other hand of the observer holds the wrist or hand of the patient in order to detect the response if it is not very brisk.

To get the **jaw jerk** the patient is told to open the mouth to its fullest extent ; a finger of the left hand is placed firmly on the front of the chin, and a sharp tap applied to it may elicit a jerk.

The presence of these minor tendon reflexes, with the exception of the Achilles jerk, may indicate that there is probably a lesion of the upper motor neurone.

Visceral or Organic Reflexes

We cannot make an actual physical examination of these, but must rely on history and symptoms. The two principal are the **rectal** and **vesical** reflexes. If the former is not intact, then disturbances in connection with defæcation occur; if the latter is impaired, there are difficulties of micturition, either retention or incontinence.

Cranial Nerves

Now we come to the **base of the brain,** and the cranial nerves will give a clue as to its condition. We take these nerves in order.

1. **Olfactory.**—Its origin is in the olfactory bulb, and its distribution is in the upper third of the nasal mucosa, the fibres passing vertically from origin to distribution through the cribriform plate of the ethmoid bone.

To test the nerve we make the patient smell, first with one nostril and then with the other, unpleasant and pleasant substances, such as asafœtida, oil of cinnamon, etc. It is not permissible to use substances like ammonia, which stimulate mechanically. If he can recognise pleasant and unpleasant odours, we know that the nerve is healthy. Loss of power to recognise odours is known as *anosmia*; if pleasant are mistaken for unpleasant odours and *vice versa,* the condition is known as *parosmia.*

2. **Optic Nerve.**—The fibres arise from the ganglion cells of the retina, and pass backwards in the trunk of the optic chiasma, where the fibres divide into two sets, the inner half crossing to the opposite side, the outer

half passing on. The outer and inner halves from the different sides unite behind the chiasma to form the optic tract. This, in its passage backwards, divides into two parts, the outer of which ends in the optic thalamus and the external geniculate body, the internal forming connections with the anterior corpora quadrigemina. From the external geniculate body and optic thalamus the external portion is carried through the optic radiation by fresh neurones to the visual area in the occipital lobe ; they are concerned in the visual function. From the anterior corpora quadrigemina, fibres pass down to the nuclei of the third, fourth, and sixth nerves. They are known as Meynert's fibres and are concerned especially with the light and accommodation reflexes and with the movements of the eyes.

In examining this nerve we first test the **acuity of vision.** Either eye is tested separately at a distance of 20 feet by asking the patient to read letters on a card, decreasing in size from above down, which are of the following numerical values :

60 . . If he reads this only, we say that his vision is 6/60 V. = 6/60.

36 . . If he reads this only, we say that his vision is 6/36 V. = 6/36.

24 . . If he reads this only, we say that his vision is 6/24 V. = 6/24.

18 . . If he reads this only, we say that his vision is 6/18 V. = 6/18.

12 . . If he reads this only, we say that his vision is 6/12 V. = 6/12.

6 . . If he reads this only, we say that his vision is 6/6 V. = 6/6.

5 . . If he reads this only, we say that his vision is 6/5 V. = 6/5.

If V. = 6/6 it is normal. He may not be able to read at all at 6 metres or 20 feet, and we then bring him nearer. If he can read 60 at 3 metres V. = 3/60, and so on. If he cannot distinguish the letters at all, we ask him to *count fingers* at a distance of 20 feet or nearer; and if he cannot do this, we test to find out if he can distinguish *hand movements*. He may not be able even to do this and may only be able to say whether it is dark or light. This is known as p.l., or *perception of light*. If we find by examination with the ophthalmoscope that the refracting media are healthy, any loss of visual acuity is probably due to disease of the optic nerves or centres.

Now we come to the **third, fourth,** and **sixth nerves.** The third supplies, in addition to the levator palpebræ superioris, all the extrinsic muscles of the eyeball except the superior oblique, which is supplied by the fourth, and the external rectus which gets its supply from the sixth. The third nerve also supplies the ciliary muscle and the constrictor pupillæ. If the **third nerve** be diseased, there is drooping of the upper eyelid, the eyeball can be moved only outwards, and the pupil is dilated. Probably the eyeball will be turned outwards; this is known as **strabismus** or squint—in this case external. The patient complains of double vision—**diplopia.**

If the **fourth nerve** be affected, there is double vision, the power of looking downwards is diminished, and, when the patient does attempt to look downwards, the eyeball is rotated outwards owing to uncorrected action of the external rectus. **Sixth nerve** paralysis is manifested by loss of power to move the eyeball outwards, and there may be internal strabismus and double vision.

In examining these nerves the patient is made to look at the forefinger of the observer held about 2 feet in front of him, and is told to hold his head steady, and to

follow with his eyes the finger, which is moved upwards, downwards, outwards, inwards, and circumducted. The observer notes any lack of movement in any direction, and the patient is interrogated with regard to the presence of double vision or diplopia.

Power of **accommodation** is tested by holding the forefinger at a distance of about 3 feet in front of the patient and bringing it gradually nearer. The patient keeps his eyes fixed on it. The pupils should contract and the eyeballs converge. In *exophthalmic goitre* the power of convergence is impaired or lost.

In examining the **light reflex** the patient is placed facing a good light. The observer places a hand over either eye, and, asking the patient to look steadily in front at the far distance, removes one hand. If the light reflex be present, the pupil will contract. Another method is to throw a bright beam of light into the eye by means of the mirror of an ophthalmoscope. The light reflex is **lost** in certain cases of local eye disease, in *locomotor ataxia* and *general paralysis of the insane.* In the two latter diseases the accommodation reaction is present, although the light reflex is not, and the condition is known as the **Argyll-Robertson pupil.**

The **fifth nerve** supplies sensation to the tongue, the lips, the mucous membrane of the nose, as well as motor power to the muscles of mastication. Sensation is tested in the usual way ; the motor power is tested by making the patient clench the teeth, and the physician feels whether the Masseter muscle contracts. The patient is asked to open his mouth ; if the nerve is diseased on one side, the jaw is deviated to that side.

The **seventh or facial** is purely a motor nerve. It supplies the muscles of the face. To examine its condition one asks the patient to wrinkle the forehead and to frown, to open and shut his eyes, to show the teeth,

and to whistle. If there be facial nerve paralysis on one side, the face is drawn to that side, especially when the patient attempts to perform the prescribed movements. Apart from these movements, however, even in repose the face loses its furrows on the paralysed side, and the patient is not able to close the eye properly on that side.

Eighth or auditory nerve—nerve of hearing. The **power of hearing** is estimated by means of a watch. The distance at which the patient can hear the watch with either ear is compared with that at which healthy people can detect it. If the hearing be impaired, we should have the external auditory meatus and tympanic membrane examined. As a rule, unless the cause of the deafness is an obvious one, the case should be referred to a specialist in ear diseases.

We must note, also, whether the hearing is more acute than normal. This condition is known as **hyperacusis** and is often associated with disease of the facial nerve, owing to the fact that that nerve gives off a branch to the stapedius.

If the patient can hear the watch when it is applied to the temporal region or held between the teeth but cannot hear it in the ordinary way (the external auditory meatus and tympanic membrane being healthy), we assume that the middle ear is affected.

Ninth or Glossopharyngeal.—To test this nerve we require two powders, one bitter and one sweet. Those usually employed are sugar and quinine. The tongue is protruded, and first one powder is rubbed on its posterior third and then the other, first on the right side and then on the left. The patient is asked, "Is it sweet?" "Is it bitter?" and indicates assent or dissent by nodding or shaking the head as requisite. In **paralysis** of this nerve the sense of taste is absent in

the posterior third, sensation is lost in the upper part of the pharynx, and there is some disturbance of swallowing. (The nerve supplies the posterior third of the tongue with taste, motor power to the middle constrictor of the pharynx, and common sensation to the pharynx and back of the tongue.)

Tenth, Vagus or Pneumogastric.—If this nerve be affected, there is regurgitation of food, especially of fluids, through the nose, and difficulty in saying certain words or letters, such as "g" and "b." The vocal chords are affected so that there is some interference with the voice or respiration. In addition, there is tachycardia and difficulty in swallowing; vomiting, yawning, sighing, and hiccough may be present in bad cases of vagus paralysis. (The vagus has a very extensive distribution to the larynx, lungs, œsophagus, heart, stomach, intestines, and other abdominal viscera, and to the muscles of the palate, larynx, and pharynx.)

Eleventh or Spinal Accessory.—This supplies the trapezius and sternomastoid muscles, and the accessory part is said to supply the palate through the vagus and pharyngeal plexus. It is tested by making the patient shrug the shoulders and turn the head from side to side against resistance.

Palatal Reflex

With reference to the ninth, tenth, and eleventh nerves, the **palatal reflex** should be mentioned. The afferent nerve is the glosso-pharyngeal, supplying the pharynx; the efferent is the accessory portion of the spinal accessory, distributed through the vagus. The reflex movement is elevation of the palate when the pharynx is tickled. If, then, the ninth, tenth, or accessory portion of the eleventh nerve be affected,

the reflex will be abolished, on one side if the lesion is unilateral, on both if bilateral.

Twelfth or Hypoglossal.—It supplies motor power to the tongue. If it be paralysed on one side, the tongue is pushed over to that side when protruded. Care must be taken when there is facial paralysis present, because, in such cases, if we do not take heed of the relation of the tongue to the central incisors, we may imagine that it is not protruded properly.

Gait

The **gait** of the patient is an important point, especially in nervous cases. The following are the more important types of gait to be met with in diseases of the nervous system.

The Ataxic Gait.—In this condition the patient manifestly has not got proper control over his legs. They are thrown about as he walks, his progress is unsteady, and he is apt to totter or even fall when turning. It is found in cases of *locomotor ataxia* and in some rarer conditions.

High-stepping gait is found in cases of *peripheral neuritis*. The foot is lifted high off the ground and is brought down flat, not with the heel first as is usual. The toes are dragged forward on the ground owing to paralysis of the muscles in front of the leg.

The Spastic Gait.—In this case the legs are held stiffly in a condition of extension, and the foot is not raised properly from the ground. The ball of the foot is scraped along without being raised. It is found in *disease of the upper motor neurones.*

Reeling Gait.—The person walks as if he were under the influence of alcohol, and staggers unsteadily about from side to side. It is found in cases of *cerebellar*

disease and *disease of the internal ear* involving the semi-circular canals and labyrinth.

The gait of a **hemiplegic** is also characteristic. One leg is stiffly held in extension and is swung outwards as it is moved forwards. The whole attitude of a person suffering from hemiplegia is characteristic.

A **festinating gait** is met with in cases of *paralysis agitans*. The patient hastens onwards in a stooping attitude and appears to be constantly on the point of falling forwards.

Co-ordination

The **co-ordinating power** of the patient should now be tested. He is told to place his right heel on his left knee and *vice versa*, to extend and flex his legs rapidly, to bring the tips of the fingers of the right and left hands together and to touch the point of the nose, first with the right and then with the left forefinger. All these movements should be performed with the eyes shut. He may also be made to pronate and supinate the clenched hands rapidly or to open and shut them quickly. In persons suffering from inco-ordination such movements cannot be carried out properly. The **power of equilibration** is of importance, and is tested by making the patient stand with his feet close together, his hands by his sides and his eyes shut. If he cannot do this, but falls or tends to fall, we say that **Romberg's sign** is present or positive. It is met with in *locomotor ataxia*. The patient should also walk along a line, placing the heel of the right foot against the toe of the left, and so on. He should do this without staggering.

Another condition which is of importance in certain nervous diseases is **nystagmus.** When the patient is made to fix a point with his eyes, to the extreme right or left, or up or down, or, in other words, when certain

of the muscles of the eyeball are put on the stretch, in some nervous conditions these go into a condition of clonic spasm so long as the strain is kept up and the eyeballs are made to perform a series of jerks. It is met with in *disseminated sclerosis*, but it is also found in high degrees of *myopia*, especially in albinos and among coalminers. An acquaintance with these peculiarities of gait and other nerve conditions is far more readily acquired by demonstration on a patient than by any quantity of description.

Speech

The **speech** is of great importance. The condition of **aphasia** is one in which the patient is unable to express himself in words. This does not necessarily mean that he cannot speak. He may be able to utter words, but they are not those which he wishes to say and do not form intelligible speech. Such a condition is due to a lesion of the sensory reception- and retention-apparatus—the mechanism for associated ideas and words—and is known as **sensory aphasia.** If the patient is fully aware of what he wants to say, and can associate the ideas and words, but cannot utter the latter owing to failure of the speech mechanism, we say that he has **motor aphasia. Agraphia** is loss of the power of writing, and it, also, may be motor or sensory. The speech may be imperfect owing to difficulties in articulation. In cases of *hemiplegia*, owing to the paralysis of the face-muscles, the speech is very indistinct. In *paralytic dementia*, or general paralysis of the insane, it is slurring; words are slurred or cut short.

In *disseminated sclerosis* the syllables of a word are pronounced separately and sharply.

The **memory** and the **general intelligence** should also

be tested if we have not already formed an opinion from what we have seen of the patient. The memory should be tested both for recent and remote events. This, perhaps, comes under the department of mental diseases rather than that of general medicine, but now that so many cases of *shell-shock* and *neurasthenia* are occurring, it is well for the student to become acquainted, generally, with the testing of all mental processes.

CHAPTER VII

EXCRETORY SYSTEM

URINE—ABNORMAL CONSTITUENTS—CHEMICAL AND MICROSCOPICAL EXAMINATION

Urine

The urine should be examined in every case; one never knows when valuable information may be obtained from it.

Quantity.—The usual quantity excreted in twenty-four hours is 1,500 c.c., or about 50 ozs. This amount may be *exceeded physiologically*, owing, for example, to exposure to cold, imbibition of large quantities of fluid, in certain nervous conditions, to taking certain drugs—diuretics.

It may be *increased pathologically*, for example, in *diabetes mellitus* and *insipidus*, and in *chronic interstitial nephritis* with high blood-pressure. The amount may be *diminished physiologically* by profuse perspiration and by abstinence from fluids, and *pathologically* in *acute, subacute,* or *chronic parenchymatous nephritis*, in *fever* and profuse *diarrhœa*, particularly in *cholera.*

Anuria is a stoppage of excretion of urine, in other words, suppression. This may be associated with *uræmia, cholera,* and the administration of *overdoses of certain drugs, e.g.* cantharides.

Colour.—The usual colour is straw-colour or amber,

but it varies, physiologically, with the quantity. As a rule, the smaller the quantity the deeper the colour, and *vice versa*.

Pathologically, there are numbers of substances which produce a change in the colour.

(1) **Blood.**—This may give anything from a mere smoky tinge up to a bright red colour, according to the amount of blood present; indeed, there may be blood in the urine without our being able to detect any change in colour.

(2) **Bile** gives a greenish tinge to urine.

(3) **Drugs** may give to it an adventitious colour; santonin gives a bright yellow, and carbolic acid green.

(4) **Alkapton** (Alkaptonuria).—In this condition the urine becomes black on standing. This is due to the presence of homogentisinic acid, which is formed owing to the imperfect oxidation of certain amino-acids—tyrosin and phenyl-alanin.

(5) **Black-water Fever.**—The urine in this disease is of a dark brown or even black colour due to the presence of hæmoglobin compounds, especially methæmoglobin. In **hæmatoporphyrinuria** the urine is black, and this is found in *sulphonal poisoning* and other rare conditions.

(6) **Milky.**—In **chyluria** the urine has a milky appearance.

Odour.—The odour of the urine is usually described as aromatic. In acetonuria it has a sweet odour like that of apples.

Urine which has stood for a long time, or has undergone fermentation in the bladder in cases of cystitis or retention has an ammoniacal smell.

Specific Gravity.—This is usually 1015–1025 and depends on the amount of solids dissolved in the urine. Physiologically the smaller the quantity of urine passed the higher is the specific gravity. It is very high in

cases of **diabetes mellitus**—1035 or over. That of the urine of **diabetes insipidus** is about 1002–1006, and in that of **chronic interstitial nephritis** it is also very low, 1010 or thereby.

Reaction.—The reaction is usually acid or amphoteric. The acidity is due to the presence of acid sodium phosphate. The urine passed about an hour after a meal is alkaline—the alkaline tide—and so is the urine of vegetarians. It is also alkaline in some cases of cystitis when the urine is ammoniacal, and an alkaline reaction is produced by taking drugs like bicarbonate or citrate of sodium or potassium. As a rule in cases of fever the urine becomes distinctly acid.

Abnormal Constituents

Before proceeding to examine the urine further, we must make sure that it is quite clear. If it is turbid, it should be filtered; if this does not remove the turbidity, even when repeated, the cloudiness is probably caused by the presence of micro-organisms. These may be removed by means of a good centrifuge, but if such an apparatus is not available, we must use other methods. If we render the urine alkaline by means of a solution of caustic soda, a deposit of earthy phosphates is thrown down, and when this is removed by filtration the bacteria are filtered off also. Another method is to shake with barium chloride and then filter.

We now proceed to examine for abnormal constituents. The first of these is **albumin,** which, in this connection, means serum albumin and serum globulin.

(1) **Heat Test.**—The urine must be acid, and, if necessary, a few drops of dilute acetic acid must be added to about 2 inches of urine. Care should be taken not to add too much acid, otherwise soluble acid albumin is

formed. The urine being acid, then, we heat the upper part of the column in the tube. A white cloud appears if albumin is present. If it still persists after adding a drop or two of nitric acid, we know that it cannot be due to earthy phosphates, nucleo-albumin or mucin.

(2) **Heller's Nitric Acid Test.**—Take about half an inch of nitric acid in a test-tube and allow an equal amount of urine to flow gently down on it. The tube containing the nitric acid should be held as nearly horizontal as possible, and the urine should be allowed to flow on to it from a pipette. If no pipette be available, another test-tube may be used for the purpose. The two tubes should be held in such a way that the palms of the hands are uppermost. If we hold them thus we can see what we are doing. You will find that if you hold the tubes with the palms of the hands turned downwards, you do not see what is taking place. The urine is poured on to the surface of the nitric acid, because, being lighter, it will float and a sharp line of contact will be produced. If a white ring appears at the junction of the fluids, it is probably due to the presence of albumin. It is advisable to let the tube sit for five minutes before concluding that no ring is going to appear. There are certain substances which may lead to errors being made: (*a*) *albumoses*—the ring, however, disappears on heating, whereas that produced by albumin does not; (*b*) *resins*—the ring disappears with the addition of half the volume of rectified spirit; (*c*) *urea nitrate*—the ring is crystalline in appearance and occurs all through the urine; moreover, it can be prevented from appearing by diluting the urine. The significance of albumin in the urine may be great or trifling; it depends on the presence or absence of tube casts. In their presence it will indicate renal disease, in their absence it may not indicate any serious pathological condition. Its absence when it is

tested for clinically by the above methods does not absolutely preclude disease of the kidneys.

(3) **Salicylsulphonic Acid Test.**—When the necessary reagent can be obtained, this test is far more reliable than either of the above. A few drops of the reagent are added to an inch of urine in a tube. If albumin be present, a white cloud forms.

Sugar.—The variety of sugar which we usually have to test for is glucose. Lactose may be found in the urine of lactating women, but it is not of any importance. The usual tests for **glucose** depend on the fact that it is a reducing agent, and that, on boiling, it has the power of precipitating a copper salt (namely, cupric hydrate) held in solution, as insoluble cuprous hydrate.

The first of these tests is **Trommer's.** A few drops of a weak solution of copper sulphate are put in a test-tube and about 1 inch of a 1% solution of sodium hydrate is added. A blue precipitate of cupric hydrate is formed. An inch of urine is added to this, and, if sugar be present, a deep blue solution occurs. The glucose has the power of holding the cupric hydrate in solution. The deep blue solution is now heated, and, if glucose be present, a yellow or red precipitate is thrown down consisting of cuprous hydrate. *Remember that it is not merely a yellow colour, but a thick, yellow precipitate.*

The next test is **Fehling's.** Fehling's solution is really cupric hydrate kept in solution by the addition of acid sodium tartrate—Rochelle salt. One inch of this solution is placed in a test-tube and boiled. No change should occur. If the solution be old, it may be reduced spontaneously on heating, and thus the test may be spoiled. If the solution remain clear, an equal quantity of the urine to be tested is boiled and added, and the mixture is heated to boiling. If glucose be present, it

will cause a reduction of the cupric hydrate and a thick, yellow precipitate will be thrown down. (It is advisable to keep the sodium hydrate and Rochelle salt solution separate from the solution of sulphate of copper. The reagent employed for the test consists of equal parts of these. In this way the solution is kept from deteriorating.)

Fallacies.—Certain drugs when taken medicinally may appear in the urine, and, by acting as reducing agents, may give rise to error ; such are chloral, chloroform, camphor, antipyrin, glycerine, salicylates, and antifebrin. Other substances which may occur in the urine and act as reducing agents and sources of error are uric acid, hippuric acid, creatinine, glycuronic and glycosuric acids, and alkapton. If albumin be present it must be filtered off after being precipitated by acidifying and boiling the urine, otherwise it may complicate the test. If the urine be ammoniacal, Fehling's test should not be applied.

(If one wishes to make **confirmatory tests,** one may try to produce ozazone crystals. Phenylhydrazine hydrochloride and sodium acetate are heated with the urine in a water-bath for about ten minutes ; on cooling, if glucose be present, characteristic yellow glucozazone crystals are deposited. If further confirmation be needed, one may employ yeast to produce the well-known alcoholic fermentation with the production of CO_2, and, finally, the spectroscope may be employed.)

In connection with urines which contain sugar there are two other substances which we may have to detect : one is **acetone**, and the other is **diacetic acid ;** they are important, as their prognostic significance is of considerable value.

Acetone.—To about half an inch of urine in a test-tube we add a few drops of freshly prepared solution

of sodium nitro-prusside, made by putting a few crystals of the substance in 10 c.c. of water. The mixture is then covered with ammonia and allowed to stand for five minutes. A magenta ring appears at the junction of the two fluids.

Diacetic acid is detected by means of liquor ferri perchlor., which is added drop by drop to 10 c.c. of urine. A precipitate of phosphate of iron falls. After no more precipitate falls, if the urine is of a deep burgundy-red colour diacetic acid is present. We must be careful not to mistake the reddish brown precipitate of phosphate of iron for the deep red colour of the diacetic reaction.

Blood Pigment

The best test for blood pigment is the spectroscope, but if we have no spectroscope we can test by means of tincture of guaiacum and ozonic ether. To about 10 c.c. of urine a few drops of freshly prepared tincture of guaiacum are added. A precipitate of guaiacum resin is thrown down. Ozonic ether containing a sufficiency of hydrogen peroxide is poured on the surface. If hæmoglobin be present, a blue ring appears. The blue ring is due to oxidation of the guaiac resin by the oxygen of the ozonic ether, the hæmoglobin acting as a carrier between them. If *pus* be present, a blue ring is produced, but this appears with guaiac alone and disappears on heating. *Iodides* also give a blue ring; this does not appear merely at the junction, but all through the fluid. Hæmoglobin and its compounds and derivatives give certain *spectroscopic bands* by which they can be recognised.

Pus.—Chemical tests for pus are uncertain and are now inadmissible. The microscopic is the only trustworthy method.

Bile.—We test for the *bile pigments*—not bile salts. The urine is filtered repeatedly through filter paper. The paper is then spread out on a white surface, and a drop of impure nitric acid is placed on it by means of a glass rod. A play of colours occurs from the centre of the drop outwards—yellow, red, blue, green.

Deposits in Urine

After standing for some hours in a glass the urine may throw down a deposit. In cold climates it may be allowed to stand for a considerable time, but in the tropics, ammoniacal decomposition occurs so rapidly that our examination should be made not long after the urine has been passed. To detect a deposit the centrifuge may be necessary ; on the other hand, it may be evident to the naked eye. The following are the commonest types of deposits.

(*a*) *Unorganised Deposits*

(1) **Mucus.**—This appears after some hours as a light, semi-transparent cloud, and may be found in acid or alkaline urines. It is not affected by heating or by acids.

(2) **Urates.**—These are found in acid urines. They form a white or pinkish deposit and are increased during fever. The pink colour is due to uro-erythrin. They disappear on heating, and under the microscope they are amorphous, *i.e.* they have no definite crystalline shape.

(3) **Uric Acid.**—This substance when deposited appears like grains of red sand or cayenne pepper. The deposit is affected neither by heat nor by acids, and, microscopically, is found to consist of sheaves of crystals of a whetstone shape.

(4) **Phosphates.**—These occur in alkaline urines. The

deposit is thick and white and is dissolved by the addition of a few drops of a weak acid. It is increased on heating. Microscopically the deposit is both amorphous and crystalline. The earthy phosphates are amorphous, while the alkaline and triple phosphates consist of crystals of various shapes; the alkaline form occurs as rhombic prisms arranged in star-like groups, (hence the term stellar phosphates,) whereas the triple phosphates present the form of the so-called knife-rest crystals of large size, or of feathery stars.

(5) Other less common deposits are **acid sodium urate** and **ammonium urate**, both of which occur as spiky balls. Crystals of **carbonates** are round and biscuit-shaped; **leucin** occurs as yellow balls and **tyrosine** as bundles of needles.

(6) **Oxalates** are of great importance. *Calcium oxalate* is the chief of these. With the naked eye the presence of this may be suspected from the appearance it gives of scratches on the glass, and, if there be a deposit of mucus as well, by the minute glistening points scattered through it. Under the microscope the crystals are of the so-called *envelope* shape.

(*b*) *Organised Deposits*

(1) **Blood.**—This may be present in such a quantity as to be easily recognisable with the naked eye, but, on the other hand, it may be possible to detect it only by means of the microscope. The cells are mainly red blood cells with some leucocytes. (It is necessary for everyone to become familiar with the microscopic appearance of deposits. Constant practice will ensure the student such an intimate knowledge of these that he will not make mistakes.)

(2) **Pus.**—If much pus be present it forms a heavy, white deposit at the bottom of the glass.

There is, as we have seen, no trustworthy chemical test for pus. We rely on the microscope for our diagnosis. (Like all other deposits, pus may be present in so small an amount as to be unrecognisable to the naked eye without the use of the centrifuge, and even after centrifuging the deposit may be very small. To prepare the deposit for microscopic examination, we require a clean slide and cover-glass, and a pipette with a rubber teat attached. A little of the deposit is sucked up by means of the pipette and ejected on to the slide. Care must be taken to take up sufficient urine, otherwise air-bubbles will get in and the slide will be unsatisfactory. Care, however, must also be taken not to take up or eject too much, otherwise the cover-glass will float about and an untidy mess will be the result. Always examine with the low power first and with the light slightly shut off. Having located the object you wish to examine more closely, you then put on the high power. A mechanical stage by which the slide can be moved from side to side and backwards and forwards so that the whole can be examined and no part missed, is of great service.)

Pus cells are round and granular under the microscope. The nucleus is rendered more distinct by adding a drop or two of 2% acetic acid to the wet film.

(3) **Fat globules** may be found in the urine in *chyluria*. They are highly refractile, structureless rings.

(4) **Epithelial Cells**.—(*a*) *Renal:* usually round or cubical and the nucleus is very often quite distinct. They are larger than pus cells. (*b*) *Vaginal:* these are very large, irregularly-shaped squames with a large and distinct nucleus. (*c*) Cells from the *pelvis of the kidney*, the *ureter*, and the *bladder:* they are transitional epithelial cells and are irregularly shaped, many of them being tailed; they are often found in groups all fitted into one another.

(5) **Casts :** (*a*) *Hyaline.*—These are clear, homogeneous, transparent, ribbon-like structures. They must not be confused with threads of fibrin or linen or of other substances.

(*b*) *Epithelial Casts.*—These are simply hyaline casts to the surface of which renal cells are adhering. The cells are usually breaking down.

(*c*) *Granular Casts.*—These are hyaline casts covered with granules which, probably, are derived from the breaking down of renal cells. Care must be taken not to mistake for these pieces of amorphous, granular deposits of urates.

(*d*) *Blood casts* are hyaline casts to the surface of which blood cells are adhering. They are usually associated with acute renal disease.

(*e*) *Fatty Casts.*—They closely resemble the hyaline variety but are somewhat larger.

(6) **Spermatozoa** may be present.

(7) Thread-like structures known as **prostatic threads**, resulting from inflammation of the prostate gland, are visible to the naked eye.

(8) **Pieces of tumour** and **masses of fibrin** may be found.

(9) **Parasites.**—Their **ova** or **embryos :** the ova of *schistosomum hæmatobium* and the embryos of *filaria sanguinis hominis.*

(10) **Bacteria.**—Unless the urine has been freshly and aseptically collected by means of a catheter, no inference can be drawn from the presence of bacteria.

CHAPTER VIII

MICROSCOPICAL EXAMINATION

EXAMINATION OF FÆCES, SPUTUM, BLOOD, ETC.

(1) Fæces

Examination for (*a*) **Amœbæ.**—If possible, the stool should be examined when freshly passed, otherwise the amœbæ will have lost their power of movement and may even have become encysted. A piece of mucus about the size of a small pea is picked up with a forceps and put on a slide, which should be warmed if necessary. In tropical countries, however, this is not required. A cover-slip is then put over the piece of mucus and is pressed down fairly firmly so as to get the mucus evenly spread out. We examine with the low power and then with the high. The film, while it should not be too thick, should contain sufficient material to make a diagnosis and should be moved from side to side and backwards and forwards until the whole has been traversed. The amœbæ, in the fresh state, should be seen projecting their pseudopodia. They very often contain red blood cells. In stools which have stood for some time encysted forms may be found. With practice these cysts can be diagnosed with a reasonable degree of certainty.

(*b*) **Ova.**—In examining for ova we take a drop of water or saline solution of medium size on a slide. With

a forceps, piece of wood, or any similar implement a small piece of stool is picked up and rubbed in the water or saline until a fairly thick suspension results, when we put on a cover-glass and examine with a low power, using the mechanical stage to make a complete survey. The light should not be full on but should be sufficiently shut off by the iris diaphragm.

Having detected what appears to be an ovum, one proceeds to examine it more closely with the high power if there be any dubiety. The commonest ova are (*a*) the **ankylostomum** or **hook-worm,** (*b*) **trichocephalus dispar** or **whip-worm,** (*c*) **ascaris lumbricoides** or **round worm.** Others which may be met with are (*a*) **oncospheres of tapeworms,** (*b*) **oxyuris vermicularis** or **thread worm,** (*c*) **schistosomum japonicum,** (*d*) **strongyloides intestinalis.** The student will find that if he has these ova demonstrated to him several times by someone sufficiently versed in the subject, he will be able to diagnose them with a tolerable degree of certainty. To begin with, vegetable cells and similar structures may cause some difficulty, but with a little practice and experience there should be no further trouble. An excellent method of detecting even small numbers of ova is to make a fairly thick suspension of fæces in a mixture of equal parts of glycerine and normal saline solution and centrifuge. A fragment of cotton wool spread out like a fan is laid lightly on the surface of the fluid in the tube and is then placed on a slide and covered with a cover-glass. If ova are present, they float to the top of the fluid and, becoming entangled in the meshes of the cotton wool, are easily detected.*

There are also other parasites like monads, lamblia, and others which may be met with.

* *This method was used by the Rockefeller Commission on Ankylostomiasis in Malaya.*

It might be well to mention that "mucus" in stools usually consists of epithelial cells, and very often with these we find a number of blood cells.

(2) Sputum

The following terms are applied to the naked-eye appearance of sputum:

(*a*) *Mucous*—Clear and jelly-like.

(*b*) *Muco-purulent*—Somewhat yellowish from the presence of pus.

(*c*) *Purulent*—Yellow and composed of pus.

(*d*) *Nummular*—Found in well-marked cases of *pulmonary tuberculosis;* it consists of ragged lumps which float in water.

(*e*) *Rusty*—Mucous or muco-purulent, stained or streaked with red; characteristic of *pneumonia.* The red tinge is due to the presence of blood.

(*f*) *Prune-juice sputum*—Greenish or blackish in colour and extremely foul-smelling; it is found in cases of *gangrene of the lung.*

Bright yellow, green, or **chocolate-coloured** sputum occurs in *abscess of the liver* bursting through the lung.

Blood occurs in rupture of a blood-vessel of the lung. It may arise from a *tubercular cavity,* an *aneurismal sac,* or erosion of a blood-vessel by *commencing tubercle* or *malignant disease.*

Echinococcus Cysts.—Structures like grape-skins appear in the sputum when these cysts rupture into a bronchus.

Examination with the Microscope

(1) **Unstained.**—We simply take a piece of sputum and place it on a slide, and then press down a cover-slip on it till it forms a sufficiently thin transparent layer.

This we examine with the low power, using the high power for identification. The following may be found: (*a*) *Endothelial* and *pus cells:* the endothelial cells are often pigmented. (*b*) *Elastic fibres.* (*c*) *Ova* of *Paragonimus Westermanni.* (*d*) *Amœbæ*—from a ruptured amœbic abscess of the liver. (*e*) *Charcot-Leyden crystals*—found in asthma. (*f*) *Curschmann's spirals*—found in asthma.

(2) **Stained.—For tubercle Bacilli.**—The stain used is carbol-fuchsin and is known as Ziehl-Neelsen's stain. It is a solution of basic fuchsin and carbolic acid in water. The fuchsin is a staining reagent while the carbolic acid acts as a mordant; in other words, it makes the bacilli take up the stain better. (The method of preparing the stain may be found in books on bacteriology.)

The Method

(1) Take up a piece of thick sputum with a sterile forceps or needle and spread it on a slide evenly and not too thickly; (2) let it dry, and then fix it by passing it three times through a Bunsen flame. Never heat the slide so much that you cannot bear it against your cheek. It is very important not to over-heat. Overheating destroys the bacteria so that they cannot be seen even when stained. (3) Take some stain in a test-tube and boil it, shaking the tube well the while, otherwise the stain may shoot out *en masse*; pour it at once on the slide and let it spread out; allow it to stand for three to five minutes; pour off the stain. (The bacillus unites with the stain and forms a combination which cannot be readily decolorised by acids; in other words, the stained bacillus is acid fast.) (4) Pour on 25% H_2SO_4, and leave it for a minute; then wash in water, preferably under a tap. If the colour returns,

put on the acid again for thirty seconds and again wash. If only a trace of pink is left, the slide is sufficiently decolorised. (5) Now counter-stain by putting on a 1% watery solution of methylene blue and leaving it for about half a minute. It is then washed off; the slide is dried between layers of clean blotting-paper and passed lightly through a flame. When thoroughly dry, put it under the microscope and examine with a 1/12 lens. The bacilli stand out as pink rods and often show a number of dots along them. The other bacilli, pus cells, mucus, and so on, are stained blue.

Staining for Plague Bacilli in Sputum.—In suspected cases of pneumonic plague smear the sputum on a slide by means of a platinum loop and fix with heat. (As the disease is extremely infectious, strict precautions must be taken against spreading the contagion.) It is then stained with the carbol-fuchsin stain which we use for the tubercle bacillus diluted with water ten times. The stain is not heated, but is simply poured on the slide and left for a minute. The slide is washed and dried and examined with the oil immersion lens. The bacilli in cases of pneumonic plague are exceedingly numerous, and are short and deeply stained at each end. This is known as *bi-polar staining*. These cases must always be referred to an expert.

Examination of Blood Films

(*a*) **Wet Films.**—We take a perfectly clean and dry slide and cover-slip. Having cleaned the point of a finger with cotton wool and alcohol, and having allowed it to dry thoroughly, we prick it with a sterile needle and draw a drop of blood. To ensure that the blood will flow it is well to make the patient shake his hand vigorously before pricking and it may be necessary to put a tight band round the finger to produce congestion.

Having drawn a droplet of blood, we touch the latter with the centre of the cover-glass, which is then gently dropped on the slide. If we wish to prevent the blood from drying up we smear vaseline around the edge of the cover-glass after the film has been made. The vaseline also keeps the cover-glass steady if we wish to examine the film with the oil-immersion lens. For examining for filaria embryos or trypanosomes this method is very useful, as we can see the disturbance among the red blood corpuscles caused by their movements.

(*b*) **Stained Films.**—For the detection of malarial parasites stained films are preferable. The usual stain employed is some combination of methylene blue and eosin, such as Leishman's or Giemsa's. Leishman's stain is dissolved in methyl alcohol and has the advantage of both fixing and staining the films.

To make a film for staining, we draw blood from a perfectly clean and dry finger by means of a sharp needle as described above.

The middle of the edge of the end of a slide is dipped in the droplet of blood and is placed at one end of the flat surface of a second, perfectly clean slide, the long axes of the two slides being parallel. The blood will spread along the surface of contact. The first slide, held at an angle of 45 degrees to the second, is pulled or pushed along, and thus a thin, even film is obtained and is allowed to dry. It should not be exposed to heat.

Leishman's stain is then poured on the surface of the film and is allowed to stand for thirty to forty-five seconds, during which the film becomes fixed. Twice the quantity of distilled water is allowed to flow gently from a pipette on to the slide when it mixes with the stain ; if necessary, it is encouraged to do so by means

of a glass rod or a wooden match. A deposit is seen to occur in the mixture, which is allowed to stand for five minutes. It is a good plan in tropical countries, to prevent too rapid evaporation, to cover the slide with a bell jar while straining. The slide is then washed in distilled water and allowed to dry; it may be dried between layers of clean blotting paper, but it should not be exposed to a flame.

The film is examined with the low power and a part is picked out where the corpuscles are evenly distributed. The oil-immersion lens is then employed. Red blood cells are stained red, the nuclei of the white cells purple, acidophile granules red, and basophile blue.

When looking for malarial parasites we must not do it in a haphazard fashion, but we should begin at one end of the slide and gradually pass along to the other, using a mechanical stage, and so from end to end, shifting the slide each journey a little so that an entirely new area is surveyed.

There are several points to which special attention should be given.

(1) If you do not get good results, do not blame the stain or methyl alcohol until all other sources of error have been eliminated.

(2) See that the nuclei of the white cells are well stained —if they are not, the slide is useless and it is hopeless to look for parasites. The commonest cause of failure to get good nuclear staining is a somewhat acid reaction of the distilled water, which should be frequently renewed and should be examined from time to time.

(3) Do not allow the stain to dry up before the water is put on, otherwise a deposit will be thrown down which will interfere with the detection of parasites.

(4) If there should be a deposit, cover the slide with weak alcohol and wash rapidly in distilled water or

under a tap if the water of the latter be not acid. Take care not to wash too much with alcohol, otherwise the film will become decolorised.

(5) Do not mistake blood platelets, dirt, etc., for parasites.

Abnormal Blood Cells

In cases of suspected blood diseases it is necessary to look out for abnormal cells, such as nucleated red blood cells, poikilocytes, polychromatophilic cells, etc.

Blood Films for Filaria Embryos

These should be taken at night. A drop of blood is taken and smeared thickly on the centre of the slide, and the film thus made is allowed to dry and is fixed by heat, care being taken not to heat too much. After washing in tap water to remove the hæmoglobin, it is stained with hæmotoxylin and examined first with the low power and then with the oil-immersion.

It may be stained with Leishman's or some similar stain if hæmotoxylin be not available.

Differential Counts of Leucocytes

Stain with Leishman's or Giemsa's stain. Get an evenly distributed part of the film and examine with the oil-immersion. Move the slide along by means of the mechanical stage from one end of the film to the other and back again, each time along a new path. The most convenient classification is the following:

Polymorphonuclear
Lymphocytes { large / small
Eosinophiles
Transitionals
Large Mononuclears.

For each white cell a vertical stroke is made, with the exception of every fifth stroke in a group, which is horizontal and drawn through the previous four thus: ++++, ++++. This gives a grouping into fives and facilitates counting; 300 at least should be enumerated; if possible, however, 500 are counted.

Conclusion

The student should now proceed diligently to apply what he has learned by examining all the cases he possibly can. Both now and afterwards he must remember that there are many methods which he cannot employ himself but which experts can employ for him, and that any medical practitioner who does not have recourse to all modern methods when they are available, is guilty not only of gross negligence, but also of crass ignorance and obstinate folly.

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